SCIENCE-X

MODULE - 1

INDEX

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CHEMICAL REACTIONS AND EQUATIONS

INTRODUCTION

We observe many chemical changes taking place in our daily life. The milk turns sour if kept for a long time at room temperature, milk changes to curd, rusting of iron, digestion of food in our body are examples of chemical changes.

In such changes, the nature and the properties of the substances change and we say a chemical reaction has taken place.

A chemical reaction is represented by a chemical equation which is a convenient way of describing a chemical reaction with the help of symbols of elements and formulae of chemical compounds.

In this chapter, we shall discuss about chemical formulae, chemical equations, balancing of chemical equations and types of chemical reactions.

- **Physical change :–** A change in which the physical properties of the substance changes but the chemical composition does not change. The substance is restored to its original state as soon as the cause of change is withdrawn.
- **Chemical change :–** In a chemical change, at least one of the reacting substance changes into a new substances with a different composition. The new substances can not be changed back to the original substance even if the cause of change is withdrawn.

DIFFERENCE BETWEEN PHYSICAL & CHEMICAL CHANGE

S.No.	Physical change	Chemical change
1	The identity of the substance is maintained.	The identity of the original substance is completely lost.
2	The change is temporary, the substance returns to its original state as the cause of. change is withdrawn	The change is permanent.
3	No new substance is produced.	A new substance is always produced.
4	Heat change may or may not occur.	Heat change may occur.
5	Only the physical state or some of the physical properties of the substances are changed	The substance after the change can not come back to its original state even when the cause of change is withdrawn.
6	Eg. Iron tawa is left exposed to air, melting of wax.	Eg. Fermentation of rice, breathing, curding of milk.

CHEMICAL REACTION

The processes, in which a substance or substances undergo a chemical change to produce new substance or substances, with entire new properties, are known as chemical reaction.

The nature and identity of products totally changes from the reactants.

Some important characteristics of chemical reactions are:

(i) Change in state: The physical state of the substances normally changes.

e.g (a) Formation of solid MgO from solid Mg and gaseous O_2.

(b) Formation of solid PbI(ppt) from liquid solutions of $PbNO_3$ and KI.

(c) Formation of H_2 gas from the reaction of solid Zn with liquid H_2SO_4.

(ii) Change in colour : In some of the chemical reactions change in colour can be observed.

e.g. (a) Formation of brown rust on black iron nails.

(b) Formation of yellow ppt. of lead iodide from colourless solution of $PbNO_3$ and KI.

(iii) Evolution on a gas: In some cases, a gas may be evolved.

e.g. (a) Evolution of H_2 gas, in the reaction between Zn and dil HCL

(b) Evolution of CO_2 gas, during burning of any fuel, which contains carbon.

(iv) Change in temperature: Most of the reactions are accompanied by temperature change. i.e. increase or decrease in temperature.

e.g. (a) In the reaction between Zn and H_2SO_4, flask was found to be warm. Thus rise in temperature has taken place.

(b) If a reaction between barium hydroxide, $Ba(OH)_2$ and ammonium chloride, NH_4Cl is carried out in a test tube, it is observed that bottom of test tube becomes cooler.

Q. Check Your Concepts

From the given exaples, identify the chemical changes.

(a) Fermentation of grapes.

(b) Burning of a candle.

(c) Evaporation of alcohol.

(d) Freezing of water.

(e) Turning brown of a freshly cut apple in the air.

(f) Growth of a plant.

(g) Dissolution of sugar in water.

(h) Fading of coloured clothes in the sun.

WORD EQUATION

A chemical equation which represents a chemical reaction briefly in words is called word equation.

Example : For the example the word equation is

Sodium + water $\longrightarrow$ Sodium hydroxide + Hydrogen

Do You Know?

Reactants:- The substance or substances which takes part in a chemical reaction are called reactants.

Products:- The new substance or substances formed as a result of a chemical reaction are called products.

In the above reaction sodium & water are reactants and sodium hydroxide & hydrogen are products.

◈ RULES FOR WRITING A WORD EQUATION

(i) The substances taking part in chemical reaction, reactants are always written on the left hand side of arrow.

(ii) The substances formed after the chemical reaction, products are always written on the right hand side of arrow.

(iii) A plus sign (+) is put in between the reactants or between the products. If their number is two or more.

(iv) An arrow ($\longrightarrow$) is put between the reactants and products, the arrow shows the direction of the reaction in which the reaction proceeds. The arrow is read as **"to yield" or "to form".**

In the word equation when symbols and chemical formulae of the reactants and products are used then it is called as chemical equation.

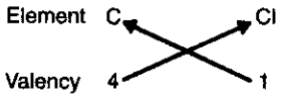
Example : $Na + H_2O \longrightarrow NaOH + H_2$

IMPORTANT TERMS AND CONCEPTS

I. Formulae of Ions

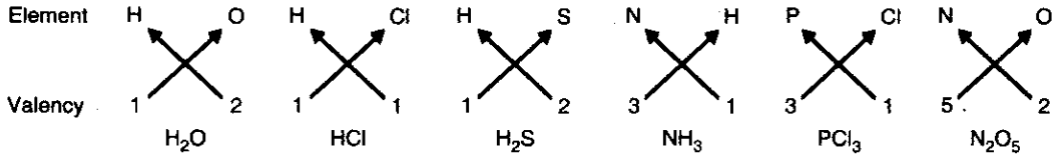
1. Valency. The number of electrons shared by an atom is called its valency. It is also called the combining capacity of an atom, e.g., Cl atom can share one valence electron, its valency is 1, Oxygen can share two valence electrons, its valency is 2. Nitrogen can share 3 valence electrons, its valency is 3, Carbon can share 4 valence electrons, therefore its valency is 4 and so on.

It means if Carbon combines with Chlorine, Carbon will share four valence electrons with four Chlorine atoms, therefore the molecular formula of the covalent compound will be



i.e. CCl_4 is formula.

Some more examples are :



+ 1 Charge Name of ion	Formula	+ 2 Charge Name of ion	Formula	+3 Charge Name of ion	Formula
Copper ion (Cuprous ion)	Cu^+	Barium ion	Ba^{2+}	Aluminium ion	Al^{3+}
		Cobalt ion	Co^{2+}	Auric ion	Au^{3+}
		Strontium ion	Sr^{2+}	Chromium (III) ion	Cr^{3+}
Potassium ion	K^+	Iron (II) ion (Ferrous ion)	Fe^{2+}	Iron (III) ion (Ferric ion)	Fe^{3+}
Silver ion	Ag^+	*Copper (II) ion	Cu^{2+}	Scandium ion	Sc^{3+}
		*Lead (II) ion	Pb^{2+}	Arsenic ion	As^{3+}
Sodium ion	Na^+	Cadmium ion	Cd^{2+}	Bismuth ion	Bi^{3+}
		Magnesium ion	Mg^{2+}	Antimony ion	Sb^{3+}
Lithium ion	Li^+	Manganese (II) ion	Mn^{2+}		
Aurous	Au^+	* mercury (I) ion	Hg_2^{2+}		
		Zinc ion	Zn^{2+}		

– 1 Charge Name of ion	Formula	– 2 Charge Name of ion	Formula	– 3 Charge Name of ion	Formula
Bromide ion	Br^-	Oxide ion	O^{2-}	Nitride ion	N^{3-}
Chloride ion	Cl^-	Sulphide ion	S^{2-}	Phosphide ion	P^{3-}
Fluoride ion	F^-			Boride ion	B^{3-}
Iodide ion	I^-				

*The elements show more than one valency. So a Roman numeral shows theft valency in a bracket.

– 1 Charge Name of ion	Formula	–2 Charge Name of ion	Formula	– 3 Charge Name of ion	Formula
Hydrogen carbonate or bicarbonate ion	HCO_3^-	Carbonate ion	CO_3^{2-}	Phosphate ion	PO_4^{3-}
Hydrogen sulphate or (bisulphate ion)	HSO_4^-	Manganate ion	MnO_4^{2-}	Arsenate ion	AsO_4^{3-}
Hydroxide ion	OH^-	Thiosulphate ion	$S_2O_3^{2-}$	Arsenite ion	AsO_3^{3-}
Nitrate ion	NO_3^-	Silicate ion	SiO_3^{2-}	Phosphite ion	PO_3^{3-}
Chlorate ion	ClO_3^-	Sulphate ion	SO_4^{2-}	Borate ion	BO_3^{3-}
Nitrite ion	NO_2^-	Sulphite ion	SO_3^{2-}	Ferricyanide ion	$[Fe(CN)_6]^{3-}$
Permanganate ion	MnO_4^-	Chromate ion	CrO_4^{2-}	**- 4 Charge**	
Acetate ion	CH_3COO^-	Dichromate ion	$Cr_2O_7^{2-}$	Carbide ion	C^{4-}
Cyanide ion	CN^-	Hydrogen—phosphate ion	HPO_4^{2-}		
Hypophosphite ion	$H_2PO_2^-$	Oxalate ion	$C_2O_4^{2-}$		
Meta aluminate ion	AlO_2^-			Ferrocyanide ion	$[Fe(CN)_6]^{-4}$
	+1 Charge				
Ammonium ion	NH_4^+				

2. Chemical Equations. "A chemical equation is a symbolic notation that uses formulae of compounds and symbols of elements to represent a chemical reaction", e.g., Copper oxide reacts with Carbon to form Copper and Carbon monoxide. The reaction may be represented as

$$CuO + C \longrightarrow Cu + Co$$

3. Writing of a Chemical Equation.

(i) The symbols of elements and the formulae of reacting substances (reactants) are written on the left hand side and plus (+) sign is written between them.

(ii) The symbols and formulae of the substances formed (products) are written on the right hand side with a plus sign (+) between them.

(iii) An arrow ($\longrightarrow$) sign in put between the reactants and products, e. g.,

$$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$$

(iv) The physical states of the reactants and products are also mentioned in a chemical equation. The notations g, l, s, aq. are written in brackets along with symbols/formulae of reactants and products. These symbols stand for gaseous, liquid, solid and aqueous solution respectively, e.g.,

$$Mg\,(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2\,(g)$$

$$Zn\,(s) + H_2SO_4\,(aq) \longrightarrow ZnSO_4(aq) + H_2\uparrow$$

The symbol (↑) may also be used to represent a gaseous product. The symbol (↓) is used to represent the formation of a precipitate (water insoluble) or a sparingly soluble substance formed during the reaction which settles down mostly, e.g.,

$$NaCl\ (aq) + AgNO_3\ (aq) \longrightarrow AgCl\ (\downarrow) + NaNO_3\ (aq)$$

(v) Sometimes, the temperature, pressure and catalyst of the reaction are indicated above and or below the arrow in the equation, e.g.,

$$CO\ (g) + 2H_2\ (g) \xrightarrow[340\,atm, heat]{ZnO/Cr_2O_3} CH_3OH\ (g)$$

(vi) A chemical equation represents an actual chemical reaction in which the reactants and products are known, e.g.,

$$2\ KMnO_4\ (s) \xrightarrow{heat} K_2MnO_4\ (s) + MnO_2\ (s) + O_2\ (g)$$

$$2\ KClO_3\ (s) \xrightarrow[MnO_2]{heat} 2\ KCl\ (s) + 3\ O_2\ (g)$$

4. Balancing of chemical equation. Observe the following two chemical equations :

$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2 \qquad \text{.....(i)}$$

$$Na + H_2O \longrightarrow NaOH + H_2 \qquad \text{.....(ii)}$$

In equation (i), the number of atoms of Zn, H, S, and O are equal on both sides, i.e., the equation is balanced.

5. Balanced Equations. The equations in which atoms of various elements on the reactant's and the product's side are equal.
Equation (ii) is not balanced because the number of hydrogen atoms is not equal on both sides. It is called a skeleton chemical equation.

6. Reason of Balancing Equations. The number of atoms of elements on both sides of a chemical equation should be equal in accordance with the law of conservation of mass.

7. Balancing. The process of making atoms of various elements equal in an equation on either side is called balancing.

8. Steps in Balancing of Chemical Equations. A number of steps are involved in balancing a chemical equation, e.g.,

$$Na + H_2O \longrightarrow NaOH + H_2$$

Step 1: Examine the number of atoms of different elements present in unbalanced equation.

	Number of atoms in reactants	**Number of atom in products**
Na	1	1
H	2	3
O	1	1

Step 2: Pick an element to balance the equation. In the above equation Na and O are balanced, Hydrogen is not.

Step : To balance Hydrogen on both sides we need to multiply H_2O by 2 which makes Hydrogen atoms equal to 4 on the reactants' side. To make Hydrogen 4 on the products' side, multiply NaOH by 2. Now oxygen has become 2 on both sides. But Sodium atom has become two on the product's side. Multiply Na by 2 on the reactant's side so that they become equal on both sides. The steps are as follows :

(i) $Na + 2H_2O \longrightarrow NaOH + H_2$

(ii) $Na + 2\ H_2O \longrightarrow 2\ NaOH + H_2$

(iii) $2\ Na + 2\ H_2O \longrightarrow 2\ NaOH + H_2$

The equation is now balanced.

Example : $Fe + H_2O \longrightarrow Fe_3O_4 + H_2$

Step 1 :

Element	Number of atoms in reactants	Number of atoms in products
Fe	1	3
H	2	2
O	1	4

Step 2 : Pick up the compound which has the maximum number of atoms whether a reactant or a product, and in that compound select the element which has the highest number of atoms, e.g., we select Fe_3O_4 in the above equation :
To balance oxygen atoms,

	In reactant	In product
Initial	1 (in H_2O)	4 (in (Fe_3O_4)
To balance	1 × 4	4 × 1

To equalise the number of atoms, we put the coefficient on the left side of the formula. A coefficient is a small whole number, like coefficients used in algebraic equations. You must keep in mind that we can put coefficients but we cannot change the subscripts in the formula, i.e., to balance Oxygen atoms, we can put the coefficient 4 as 4 H_2O and not H_2O_4 or $(H_2O)_4$. Now the partly balanced equation becomes as follows :

$Fe\ (s) + 4\ H_2O\ (g) \longrightarrow Fe_3O_4\ (s) + H_2\ (g)$ (Partly balanced)

Step 3 : Pick up the second element to balance this partly balanced equation. Let us try to balance hydrogen atoms. bIn partly balanced equation. Atoms of Hydrogen

	In reactants	In products
Initial	8 (in $4H_2O$)	2 (in H_2)
To balance	8 × 1	2 × 4

To equalise the number of Hydrogen atoms, we use 4 as the coefficient of H_2 in the products.

$Fe\ (s) + 4H_2O\ (g) \longrightarrow Fe_3O_4\ (s)\ 4H_2$

Step 4 : Pick up the third element to be balanced. The element which is left to be balanced is Fe.

Atoms of Iron	In reactants	In products
Initial	1 (in Fe)	3 (in Fe_3O_4)
To balance	1 × 3	3 × 1

To equalise iron, we use 3 as coefficient of Fe in reactants.

$3\ Fe + 4\ H_2O \longrightarrow Fe_3O_4 + 4H_2$

Step 5 : Check the correctness of the balanced equation.

Atoms	In reactants	In products
Fe	3	3
H	8	8
O	4	4

The equation is balanced because atoms of all the elements are equal on both sides. This method of balancing equation is known as hit and trial method.

9. Balancing of Ionic Equations. In these equations, charge balancing is also done along with balancing of atoms on both sides of the equation, e.g.,

Initial $Cu^{2+}(aq) + H_2S \longrightarrow CuS(s) + H^+(aq)$.

Balanced $Cu^{2+}(aq) + H_2S \longrightarrow CuS(s) + 2\,H^+(aq)$

We have balanced the charges. It was + 2 on LHS and we have made + 2 on RHS. Number of Hydrogen atoms, Cu and Sulphur atoms are also balanced on both sides.

Do You Know?

A chemical equation that conserves the amounts of all elements and electrical charges, is said to be balanced.

Q. Why is it necessary to balance the chemical equation?

Explanation

In order to make law of conservation of mass, applicable on the given chemical equation, it is necessary to make number of atoms of all elements equal on L.H.S. & R.H.S. Thus balancing of equation is required.

Q. In order to white wash a house a man mixed 10 kg of quick lime with 30 litres of water. On adding lime, he noticed that the water started boiling even when it was not being heated. Explain what is the reason behind it and write the reaction involved.

Explanation

When quick lime (CaO) was added to water, formation of slaked lime [$Ca(0H)_2$]has taken place, with the evolution of a large amount of heat. i.e. its an exothermic reaction, which caused solution to boil.

$CaO(s) + H_2O(\ell) \longrightarrow Ca(OH)_2(s) + \text{heat}$

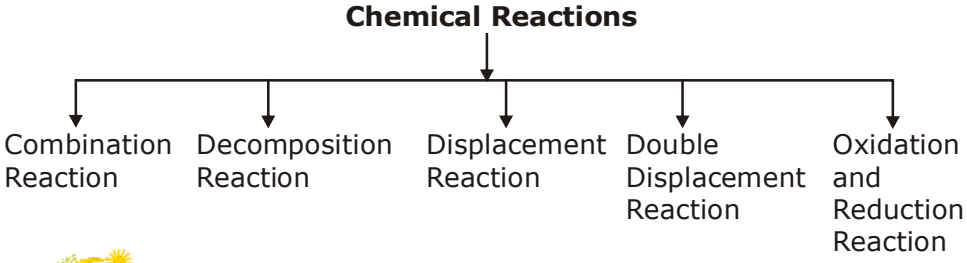
Calcium oxide — Calcium hydroxide

Do You Know?

In a balanced chemical equation an integer precedes the formula of each substance. This number is known as stoichiometric coefficient. If no number is there, stoichiometric coefficient is taken as 1.

TYPES OF CHEMICAL REACTIONS

The chemical reactions are classified into various categories depending upon the types of changes taking place. The different types of reactions are as follows :



(i) Combination Reaction. The reactions in which two or more substances combine to form a single new substance are called combination reaction.

Combination may take place,

(i) Between two or more elements.

(ii) Between two or more compounds.

(iii) Between elements and compounds.

Some more examples of combination reactions:

(a) Between two elements

(i) Burning of Coal

$C(s) + O_2(g) \longrightarrow CO_2(g)$

Carbon + Oxygen → Carbon dioxide

(ii) Formation of Water

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(\ell)$

Hydrogen + Oxygen → Water

(iii) Burning of Magnesium in air

$2Mg(s) + O_2(s) \longrightarrow 2MgO(s)$

Magnesium + Oxygen → Magnesium oxide

(iv) Formation of Iron sulphide

$Fe(s) + S(s) \xrightarrow{\Delta} FeS(s)$

Iron + Sulphur → Iron sulphide

(b) Between 2 compounds

(i) Formation of Ammonium chloride

$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$

Ammonia + Hydrogen Chloride → Ammonium Chloride

(ii) Formation of Calcium Carbonate

$CaO(s) + CO_2(g) \longrightarrow CaCO_3(s)$

Calcium oxide (Quick lime) + Carbon dioxide → Calcium carbonate

(c) Between an element and a compound

(i) Reaction of carbon monoxide with oxygen

$2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$

This is also an exothermic reactions.

Q. How the process of respiration help us to stay alive?

Explanation

The food we eat provides us the energy to stay alive. During digestion, food is broken down into simpler substances. For example, rice, potatoes and bread contain carbohydrates. These carbohydrates are broken down to form glucose. This glucose combines with oxygen in the cells of our body and provides energy. The special name of this reaction is respiration.

$C_6H_{12}O_6(aq) + 6O_2(aq) \longrightarrow 6O_2(aq) + 6H_2O(\ell) +$ energy

Glucose + Oxygen → Carbon dioxide + Water

So, we can say that respiration is an exothermic reaction.

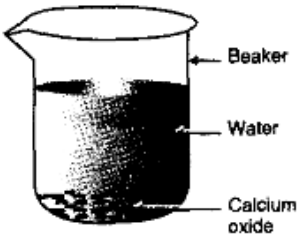
ACTIVITY - 1

⇒ **Aim :** To show the combination reaction between calcium oxide and water is an exothermic process.

⇒ **Materials Required:** Quicklime (calcium oxide), water, beaker.

⇒ **Procedure :**

1. Take 5 g of calcium oxide in a beaker.
2. Add water to it slowly.
3. Touch the beaker.
4. Note down the observations.



Formation of slaked lime by the reaction of quicklime with water

⇒ **Observation :** Calcium oxide reacts with water vigorously to form calcium hydroxide with the evolution of heat.

⇒ **Chemical Reaction :**

$CaO\ (s) + H_2O\ (l) \longrightarrow Ca(OH)_2\ (aq) + Heat$

⇒ **Conclusion :** The reaction between CaO (Calcium oxide) and H_2O is a combination reaction. It is an exothermic process because heat is evolved.

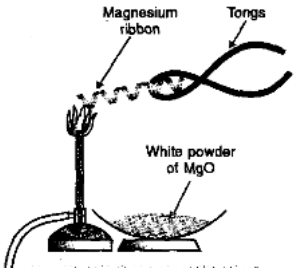
ACTIVITY - 2

⇒ **Aim:** To show burning of magnesium ribbon in air is a combination reaction.

⇒ **Materials Required:** Magnesium wire, tongs, burner.

⇒ **Procedure :**

1. Take a strip of magnesium ribbon and hold it with the help of tongs.
2. Introduce it in the flame of the burner.



⇒ **Observation :** Magnesium ribbon bums with dazzling light and white substance is formed which is magnesium oxide. This happens due to following chemical reaction.

⇒ **Chemical Reaction :**

$2\ Mg\ (s) + O_2\ (g) \longrightarrow 2\ MgO\ (s)$

⇒ **Conclusion :** Burning of magnesium in presence of oxygen to form magnesium oxide is a combination reaction.

(ii) Decomposition Reaction. A reaction in which a single compound breaks down to produce two or more simpler substances. i.e., a compound decomposes into simpler substances.
It is opposite to combination reactions.

There are three ways in which decomposition reactions can be carried out, i.e., energy required in decomposition reaction can be supplied in the following ways:
(i) Heat (ii) Electricity (iii) Light

(1) Electrolysis. When decomposition reaction is carried out with the help of electric current, the process is called electrolysis ('electro' means electric, 'lysis' means break down), e.g., when electric current is passed through acidified water (water mixed with a few drops of acid so as to make it a good conductor), it decomposes into Hydrogen and Oxygen gases.

$$2\ H_2O\ (l) \xrightarrow{electric\ current} 2\ H_2\ (g) + O_2\ (g)$$

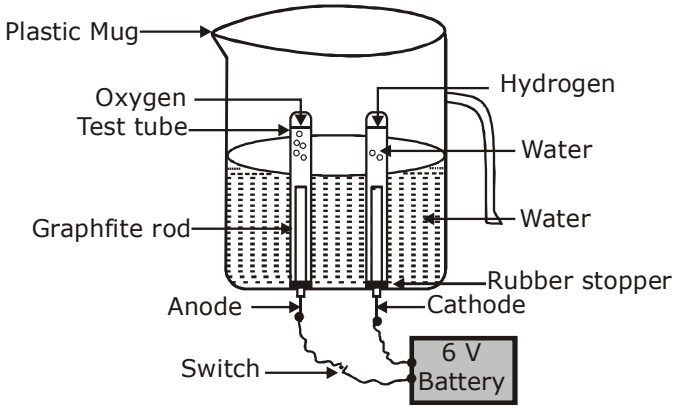
ACTIVITY - 3

⇒ **Aim :** To demonstrate electrolysis of water.

⇒ **Materials Required :** Plastic mug, drilling machine or screw driver, carbon electrodes, 6 volt battery, dil. H_2SO_4, water

⇒ **Procedure :**

1. Take a plastic mug.
2. Drill two holes at the base and insert carbon electrodes as shown in figure.
3. Fill the mug with water to its half and add a few drops of dilute sulphuric acid.
4. Fill a graduated measuring cylinder with water and invert it in the apparatus so that one of the two electrodes is enclosed within it.
5. Fill another graduated cylinder with water and invert it over the second electrode.
6. Allow the current to pass through the voltameter and leave the apparatus undisturbed for some time.
7. The bubble formation starts at both the electrodes.
8. Observe the volume of gases collected in the inverted measuring cylinders.
9. Collect the gases in respective cylinders and test them separately.
10. Bring a match stick near each of the gases in the cylinders and note down the observation and write conclusion about the gas.



Electrolysis of Water

⇒ **Observation :** The volume of one of the gases is twice the volume of other gas. One of the gases catches fire and burns with 'pop' sound whereas in other gas match stick burns brightly.

⇒ **Conclusion :** Water, on electrolysis decomposes to hydrogen gas and oxygen gas. Hydrogen gas burns explosively whereas oxygen gas helps in burning, i.e., hydrogen is highly combustible and oxygen is supporter of combustion.

(2) Thermal Decomposition. When decomposition reaction is carried out by heating, it is called thermal decomposition reaction, e.g.,

$$CaCO_3\ (s) \xrightarrow{heat} CaO\ (s) + CO_2\ (g)$$

[Limestone] [Quick lime]

$$FeSO_4\ (S) \xrightarrow{heat} Fe_2O_3 + SO_2(g) + SO_3(g)$$

[Ferric oxide]

$$2Pb(NO_3)_2(S) \xrightarrow{heat} 2PbO + 4NO_2(g) + O_2(g)$$

$$Zn\ CO_3\ (s) \xrightarrow{heat} ZnO\ (s) + CO_2\ (g)$$

The process of heating $ZnCO_3$ (Calamine), an ore of zinc in absence of air to form Zinc oxide (ZnO) and CO (g) is also called calcination.

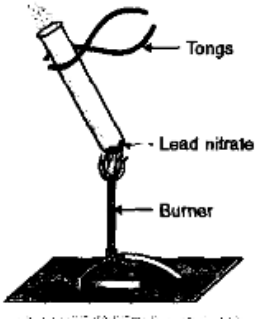
ACTIVITY - 4

⇒ **Aim :** To show heating of lead nitrate is decomposition reaction.

⇒ **Materials Required :** A test tube, lead nitrate solid.

⇒ **Procedure :**

1. Take lead nitrate (white powder) in a test tube and hold it in tongs.
2. Heat it over flame of burner slowly as shown in diagram.



⇒ **Observation :** Pungent smelling brown fumes are evolved and brownish residue is left.

⇒ **Chemical Reaction :**

$$2\ Pb(NO_3)_2 \xrightarrow{heat} 2PbO\ (s) + 4\ NO_2\ (g) + O_2\ (g)$$

⇒ **Explanation :** Lead nitrate on heating decomposes to lead monoxide (brown), brown gas nitrogen dioxide (NO_2) and oxygen gas are evolved.

⇒ **Conclusion :** It is an example of decomposition reaction.

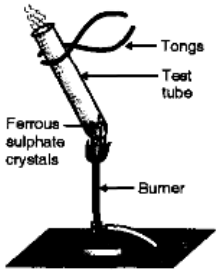
ACTIVITY - 5

⇒ **Aim :** To show decomposition reaction of ferrous sulphate.

⇒ **Materials Required :** Ferrous sulphate crystals, dry test tube, burner.

⇒ **Procedure :**

1. Take 2 g of ferrous sulphate crystals in a dry test tube.
2. Observe the colour of ferrous sulphate crystals.
3. Heat the crystals of ferrous sulphate over the flameof a burner for some time.
4. Observe the crystals after heating for 5 minutes.



⇒ **Observation :** The green colour of ferrous sulphate crystals changes to brownish black ferric oxide and smell of burning sulphur is observed.

⇒ **Chemical Reaction :**

$$2\ FeSO_4\ (s) \xrightarrow{heat} Fe_2O_3\ (s) + SO_2\ (g) + SO_3\ (g)$$

⇒ **Explanation :** Ferrous sulphate decomposes to form ferric oxide along with evolution of SO_2 and SO_3 gases.

⇒ **Conclusion :** Heating of ferrous sulphate is a thermal decomposition reaction because ferrous sulphate breaks down into simpler compounds Fe_2O_3, SO_2 and SO_3.

Do You Know?
The decomposition of vegetable matter into compost is also an example of an exothermic reaction.

(3) Photochemical Decomposition :

Chemical reaction in which a compound decomposes into simpler substances on the absorption of light energy is called photo-decomposition reaction.

$$2Agcl(s) \xrightarrow{sunlight} 2Ag(s) + Cl_2(g)$$

Silver Chloride (White) — Silver (Grey in colour)

$$2AgBr(s) \xrightarrow{sunlight} 2Ag(s) + Br_2(g)$$

Silver Bromide — Silver — Bromine

- The Decomposition of a Compound with light is called "Photolysis."
- All Decomposition reaction requires energy i.e. these reactions are "Endothermic reactions."
- These reactions are used in extractions of metals.

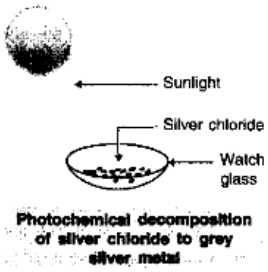
ACTIVITY - 6

⇒ **Aim :** To show photochemical decomposition of silver chloride.

⇒ **Materials Required :** $AgNO_3$ (aq), NaCl (aq), test tubes.

⇒ **Procedure :**

1. Take 5 ml of silver nitrate solution in a test tube.
2. Prepare sodium chloride solution in another test tube.
3. Add sodium chloride solution into test tube containing silver nitrate solution.
4. Observe the colour of silver chloride formed. Dry it with the help of filter papers and place it on the watch glass.
5. Place the watch glass under sunlight for some time.
6. Observe the colour of the silver chloride after some time.



⇒ **Observation :** White silver chloride turns grey in sunlight because silver metal is formed.

⇒ **Chemical Reaction :**

$$2\ AgCl\ (s) \xrightarrow{sunlight} 2\ Ag(s) + Cl_2\ (g)$$

⇒ **Explanation :** Silver chloride is photo-sensitive. It decomposes in presence of sunlight to form silver metal and chlorine gas.

⇒ **Conclusion :** Decomposition of silver chloride in presence of sunlight is photochemical decomposition reaction.

⇒ **Other examples of photochemical reactions :** Silver bromide and silver iodide also decompose in the same manner.

$$2\ AgBr\ (s) \xrightarrow{sunlight} 2\ Ag(s) + Br_2\ (g)$$

$$2\ AgI\ (s) \xrightarrow{sunlight} 2\ Ag\ (s) + I_2\ (g)$$

These reactions are photochemical reactions which are used in black and white photography. Another important example of decomposition reaction in our body is digestion of food. When we eat rice, wheat or potatoes, the starch gets decomposed to simple sugar and proteins get converted into simple substances called amino acids in our body.

$$(C_6H_{10}O_5)_n + H_2O \xrightarrow{Diastase} C_{12}H_{22}O_{11}$$

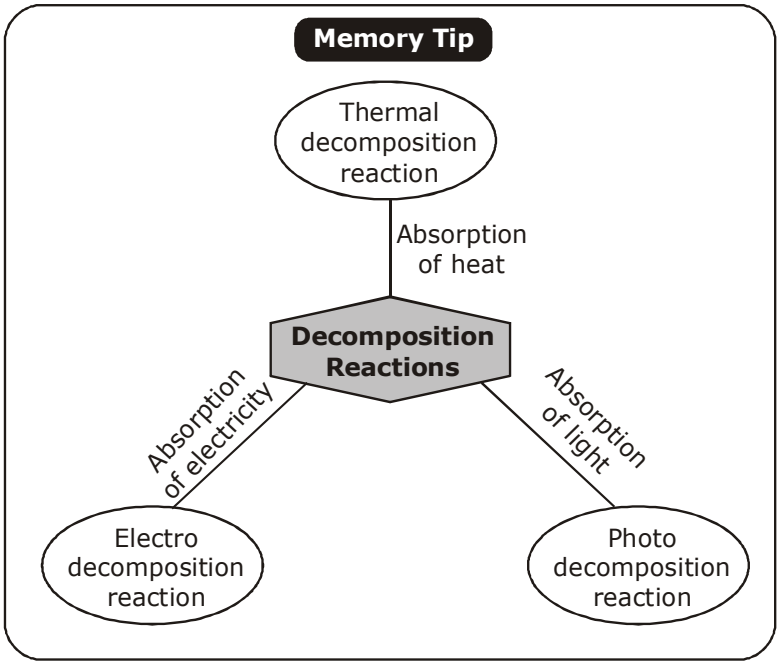
$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{Maltase} 2C_6H_{12}O_6$$

$$\text{Proteins} \xrightarrow{\text{Pepsin}} \text{Amino acids}$$

We have observed all the decomposition reactions require energy either in form of heat, light or electricity for breaking down of reactants. Therefore, they are endothermic reactions.

Endothermic Reactions: Those reactions in which heat is absorbed are called endothermic reactions.

Do You Know?
Decomposition reaction is just opposite of the combination reaction.



(iii) Displacement Reactions. Those reactions in which a more reactive element displaces a less reactive element from a compound are called displacement reactions.

Potassium	K	Most Reactive
Sodium	Na	
Barium	Ba	
Calcium	Ca	
Magnesium	Mg	
Aluminium	Al	
Zinc	Zn	
Iron	Fe	
Nickel	Ni	
Tin	Sn	
Lead	Pb	
Hydrogen	**H**	
Copper	Cu	
Mercury	Hg	
Silver	Ag	
Gold	Au	Least Reactive

DECREASING REACTIVITY

These reactions mostly occur in solution form, e.g.,

$$Zn\ (s) + CuSO_4\ (aq) \longrightarrow ZnSO_4\ (aq) + Cu\ (s)$$

Colourless Reddish brown

$$Pb + CuSO_4\ (aq) \longrightarrow PbSO_4 \downarrow + Cu\ (s)$$

It is a displacement reaction. Other examples are :

$$Mg + CuSO_4 \longrightarrow MgSO_4(aq) + Zn\ (s)$$

It shows magnesium is more reactive than Cu because it can displace Copper from Copper sulphate solution.

$$Mg(s) + ZnSO_4\,(aq) \longrightarrow MgSO_4\,(aq) + Zn\,(s)$$

$$Mg\,(s) + FeSO_4\,(aq) \longrightarrow MgSO_4\,(aq) + Fe\,(s)$$

These reactions show that Mg is more reactive than Zn and Fe.

$$Zn\,(s) + FeSO_4\,(aq) \longrightarrow ZnSO_4\,(aq) + Fe\,(s)]$$

It shows Zn is more reactive than Fe.

On the basis of the above reactions, we can conclude Mg > Zn >Fe > Pb > Cu > Ag is the order of reactivity.

$$Zn\,(s) + H_2SO_4\,(dil.) \longrightarrow ZnSO_4\,(aq) + H_2\,(g)$$

$$Mg\,(s) + H_2SO_4\,(dil.) \longrightarrow MgSO_4\,(aq) + H_2\,(g)$$

These reactions show that Zn and Mg are more reactive than Hydrogen because they displace Hydrogen from dilute acids. These are also examples of displacement reactions.

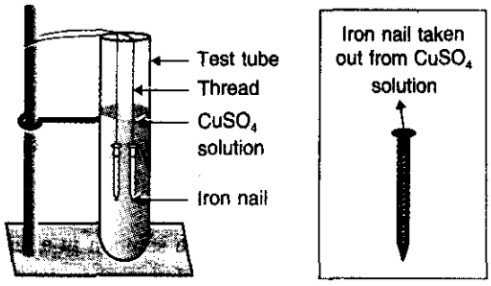
ACTIVITY - 7

⇒ **Aim:** To show iron is more reactive than copper.

⇒ **Materials Required :** Iron nails, copper sulphate solution, test tubes.

⇒ **Procedure :**

1. Take blue coloured copper sulphate solution in a test tube.
2. Put iron nails in it.



Displacement reaction of iron with copper sulphate solution

⇒ **Observation :** Colour of solution slowly changes to light green and brown coloured copper metal gets deposited over iron nails.

⇒ **Chemical Reaction :**

$$Fe\,(s) + CuSO_4\,(aq) \xrightarrow{heat} FeSO_4\,(aq) + Cu\,(s)$$

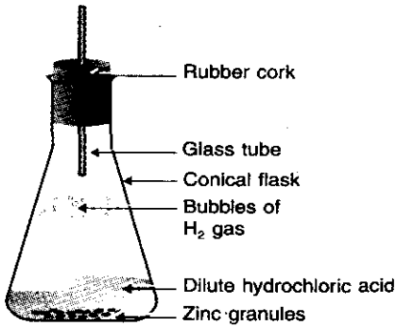
Blue Light green

⇒ **Conclusion :** Iron is more reactive than copper because iron can displace copper from copper sulphate solution. It is an example of displacement reaction.

ACTIVITY - 8

⇒ **Aim :** To show the displacement reaction between zinc granules and dilute hydrochloric ac id or dilute sulphuric acid.

⇒ **Materials Required :** Zinc granules, conical flask, dil. HCl or dil. H_2SO_4.



Formation of hydrogen gas by the reaction of dilute hydrochloric acid on zinc granules

⇒ **Procedure :**

1. Take 5-6 zinc granules in a conical flask.
2. Set the apparatus as shown in figure.
3. Add dil. HCl or dil. H_2SO_4 over it.
4. Observe the reaction.
5. Touch the conical flask and observe the change in temperature.

⇒ **Observation:** The bubbles of hydrogen gas are observed.

The conical flask becomes hot showing that the process is exothermic.

⇒ **Chemical Reaction :**

$Zn\ (s) + 2\ HCl\ (dil) \longrightarrow ZnCl_2\ (aq) + H_2\ (g)$

$Zn\ (s) + H_2SO_4\ (dil) \longrightarrow ZnSO_4\ (aq) + H_2\ (g)$

⇒ **Conclusion :** The reaction between Zn and dil. HCl or dil. H_2SO_4 is a displacement reaction.

It is exothermic process. It shows zinc is more reactive than hydrogen, therefore it can displace hydrogen from dilute acids like HCl and H_2SO_4.

(iv) Double Decomposition Reactions (Double Displacement Reactions). Those reactions in which two different atoms or groups of atoms are displaced by other atoms or groups of atoms, i.e., two compounds exchange their ions and one of the products formed is insoluble, e.g.,

$$BaCl_2\ (aq) + Na_2SO_4\ (aq) \longrightarrow BaSO_4\ (s) + 2NaCl\ (aq)$$

Here, SO_4^{2-} ions are displacing Cl^- ions and Cl^- ions are displacing SO_4^{2-} ions. Since it involves displacement of two species, therefore, is called double displacement reactions.

◈ If one of the products formed in the reaction is insoluble, it is also called double decomposition reaction.

◈ These reactions usually occur in between ionic compounds when they are dissolved in water i.e., in aqueous solution.

◈ These reactions are fast reactions and take place within fraction of a second.

Other examples of double displacement reactions are

$AgNO_3$ (aq)	+	NaBr (aq)	⟶	AgBr ↓	+	$NaNO_3$ (aq)
$AgNO_3$ (aq)	+	KI (aq)	⟶	AgI ↓	+	KNO_3 (aq)
$FeSO_4$ (aq)	+	2 NaOH (aq)	⟶	$Fe(OH)_2$ ↓	+	Na_2SO_4 (aq)
$Cr_2(SO_4)_3$	+	6 NaOH	⟶	2 $Cr(OH)_3$ ↓	+	3 Na_2SO_4 (aq)
$FeCl_3$	+	3 NaOH	⟶	$Fe(OH)_3$ ↓	+	3 NaCl (aq)
$AlCl_3$	+	3 NaOH	⟶	$Al(OH)_3$ ↓	+	3 NaCl (aq)
$CuSO_4$	+	H_2S(g)	⟶	CuS ↓	+	H_2SO_4 (aq)
$MnSO_4$	+	H_2S (g)	⟶	MnS ↓	+	H_2SO_4 (aq.)
$NiCl_2$	+	H_2S (g)	⟶	NiS ↓	+	2 HCl (aq)
$Pb(NO_3)_2$	+	2 HCl (aq)	⟶	$PbCl_2$ (s)	+	2 HNO_3 (aq)
$CaCO_3$	+	2 NaCl (aq)	⟶	$CaCl_2$ (aq)	+	Na_2CO_3(aq)
$Ca(NO_3)_2$	+	$(NH_4)_2CO_3$	⟶	$CaCO_3$ ↓	+	2 NH_4NO_3
$ZnSO_4$	+	H_2S	⟶	ZnS ↓	+	H_2SO_4 (aq)

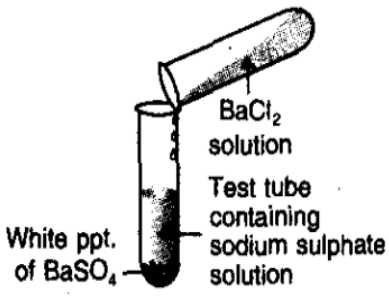
ACTIVITY - 9

⇒ **Aim :** To show reaction between sodium sulphate solution and barium chloride solution is double displacement reaction (precipitation reaction).

⇒ **Materials Required :** Barium chloride solution, sodium sulphate solution, two test tubes.

⇒ **Procedure :**

1. Take sodium sulphate solution in a test tube.
2. Add few drops of solution of barium chloride.



⇒ **Observation :** White precipitate is formed.

⇒ **Chemical Reaction :**

Na_2SO_4 (aq) + $BaCl_2$ (aq) ⟶ $BaSO_4$ ↓ + 2NaCl (aq)

⇒ **Conclusion :** Reaction between sodium sulphate solution and barium chloride solution is double displacement reaction.

ACTIVITY - 10

⇒ **Aim :** To show the reaction between lead nitrate and potassium iodide is double decomposition reaction (precipitation reaction).

⇒ **Materials Required :** Test tubes, lead nitrate solution, potassium iodide solution.

⇒ **Procedure :**

1. Take lead nitrate solution in a test tube.
2. Add potassium iodide solution to it.
3. Observe the changes taking place in the solution.

⇒ **Observation :** Yellow precipitate is formed.

⇒ **Chemical Reaction and Explanation :** Lead nitrate reacts with potassium iodide to form lead iodide which is insoluble in water and yellow in colour. It is called precipitate. The reaction is also called precipitation reaction.

$$Pb(NO_3)_2\ (aq) + 2KI\ (aq) \longrightarrow PbI_2\ (s) + 2\ KNO_3\ (aq)$$

⇒ **Conclusion :** The reaction between lead nitrate and potassium iodide is double decomposition reaction. Since Pb is insoluble called precipitate, therefore, this reaction is also called precipitation reaction.

(v) Neutralization Reactions. Those reactions in which acid or acidic oxide reacts with base or basic oxide to form salt and water are called neutralization reactions, e.g.,

$NaOH + HNO_3 \longrightarrow NaNO_3 + H_2O$

$2\ NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2\ H_2O$

$KOH + HCl \longrightarrow KCl + H_2O$

$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$

$2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

$\begin{matrix}COOH\\|\\COOH\end{matrix} + 2NaOH \longrightarrow \begin{matrix}COONa\\|\\COONa\end{matrix} + 2H_2O$

When salt of weak acid reacts with strong acid, it is also called neutralization reaction.

$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$

$CH_3COONa + HCl \longrightarrow CH_3COOH + NaCl$

When acidic salt reacts with base to form salt and water, it is also called neutralization reaction.

$NaHCO_3 + NaOH \longrightarrow Na_2CO_3 + H_2O$

(vi) Oxidation and Reduction

(1) Oxidation.

(a) It is a process in which Oxygen or an electronegative element is added.

(b) It can also be defined as a process in which Hydrogen or an electropositive element is removed.

(c) In terms of electronic concept, oxidation is a process in which loss of electrons takes place.

$4Na + O_2 \longrightarrow 2\,Na_2O$ (Addition of oxygen)

$2Mg + O_2 \longrightarrow 2\,MgO$ (Addition of oxygen)

$Fe^{2+} \longrightarrow Fe^{3+} + e^-$ (Loss of electron)

$2\,Fe + 3\,Cl_2 \longrightarrow 2\,FeCl_3$ (Addition of electronegative element)

$Hg_2Cl_2 \longrightarrow Hg + HgCl_2$ (Removal of electropositive element)

$CH_3CH_2OH \xrightarrow[300^oC]{Cu} CH_3CHO + H_2$ (Removal of Hydrogn)

(2) Reduction.

(a) It is a process in which addition of Hydrogen or an electropositive element takes place.

(b) It is also defined as a process in which Oxygen or an electronegative element is removed.

(c) In electronic concept, reduction process involves gain of electrons.

$2\,Na + H_2 \longrightarrow 2NaH$ (Addition of Hydrogen)

$CuO + H_2 \longrightarrow Cu + H_2O$ (Removal of Oxygen and addition of hydrogen)

$Fe^{3+} + e^- \longrightarrow Fe^{2+}$ (Gain of electron)

$Hg + HgCl_2 \longrightarrow Hg_2Cl_2$ (Addition of an electropositive element)

$Cu + CuCl_2 \longrightarrow Cu_2Cl_2$ (Addition of an electropositive element)

$AuCl_3 \longrightarrow AuCl + Cl_2$ (Removal of an electronegative element)

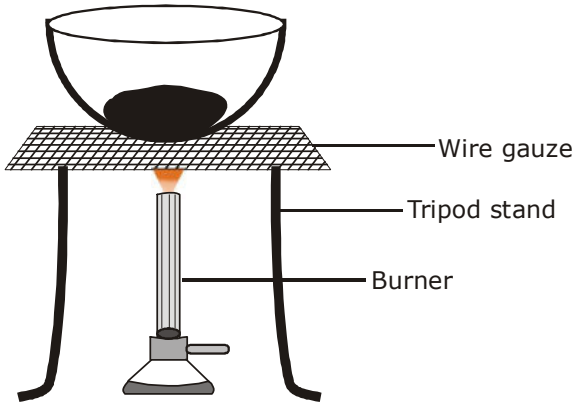
ACTIVITY - 11

⇒ **Aim:** To study oxidation of copper to copper (II) oxide.

⇒ **Method:** Heat a china dish containing about 1 9 copper powder .

⇒ **Now answer:** What do you observe?

⇒ **Discussion:** It is observed that the brown copper powder gets coated with black copper (II) oxide.



Oxidation of copper to copper oxide

⇒ **Conclusion:**

Copper (brown in colour) on heating combines with oxygen to form black copper (II) oxide.

$2Cu(s) + O_2(g) \longrightarrow 2CuO(s)$

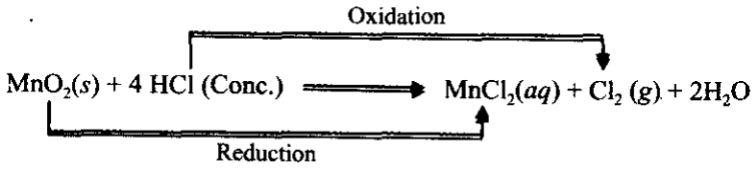
Copper(Brown) Oxygen Copper (II) oxide (Black)

Here, we can say that copper is being oxidised, as it is gaining oxygen. In the above activity if hydrogen gas is passed over product (CuO) and the black coating on the surface becomes brown because reverse reaction takes place.

$CuO(s) + H_2(g) \xrightarrow{\text{Heat}} Cu(s) + H_2O(\ell)$

Here, we can say that copper oxide is being reducing, as it is loosing oxygen and hydrogen is being oxidised.

◈ **Redox Reactions :** Those reactions in which oxidation and reduction take place simultaneously are called redox reactions, e.g.,

(i) 

$Mn^{4+} + 2e^- \longrightarrow Mn^{2+}$ (Reduction) [Gain of electrons]

$2\,Cl^- \longrightarrow Cl_2 + 2e^-$ (Oxidation) [Loss of electron]

(ii) $Cu\,(s) + I_2\,(s) \longrightarrow CuI_2\,(s)$

$Cu\,(s) \longrightarrow Cu^{2+}\,(aq) + 2e^-$ (Oxidation) [Loss of electron]

$I_2\,(s) + 2e^- \longrightarrow 2I^-$ (Reduction) [Gain of electron]

$Cu\,(s) + I_2\,(s) \longrightarrow CuI_2 + 2e^-$

$Cu\,(s) + I_2\,(s) \longrightarrow CuI_2\,(s)$ is a Redox reaction.

Oxidising Agent. It is a substance which can

(i) add oxygen or an electronegative element to other materials.

(ii) remove hydrogen or an electropositive element from other materials.

(iii) gain electrons.

Oxidising agent itself gets reduced.

Reducing Agent. It is a substance which can

(i) add hydrogen or an electropositive element to other materials.

(ii) remove oxygen or an electronegative element from other materials

(iii) lose electrons.

Reducing agent itself gets oxidised.

Example 1. $Fe + S \longrightarrow FeS$

$Fe \longrightarrow Fe^{2+} + 2e^-$ (Oxidation)

$S + 2e^- \longrightarrow S^{2-}$ (Reduction)

Fe is **losing electrons**, therefore, it acts as a **Reducing agent**.
S is **gaining electrons**, therefore, it acts as an **Oxidising agent**.
Fe is getting oxidised to Fe^{2+} (Ferrous ion) whereas S gets reduced to S^{2-} (Sulphide ion)

Example 2. $Cu\ (s) + 2AgNO_3\ (aq) \longrightarrow Cu\ (NO_3)_2\ (aq) + 2\ Ag\ (s)$

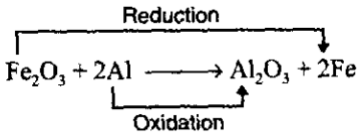
$Cu\ (s) \longrightarrow Cu^{2+} + 2e^-$ (Oxidation)

$2\ Ag^+ + 2e^- \longrightarrow 2\ Ag$ (Reduction)

$Cu\ (s) + 2\ Ag^+\ (aq) \longrightarrow Cu^{2+}\ (aq) + 2\ Ag\ (s)$

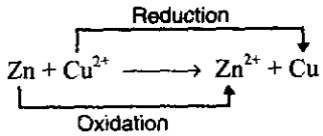
Cu is a reducing agent because it is losing electrons whereas Ag^+ is an oxidising agent.

Example 3.



Fe_2O_3 is an oxidizing agent whereas Al is a readucing agent.

Example 4. $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$



Zn is a reducing agent whereas Cu^{2+} is an oxidizing agent

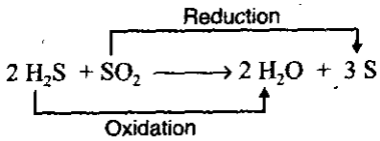
Example 5. $2\ Na + Cl_2 \longrightarrow 2NaCl$

$2\ Na \longrightarrow 2\ Na^+ + 2e^-$ [Oxidation]

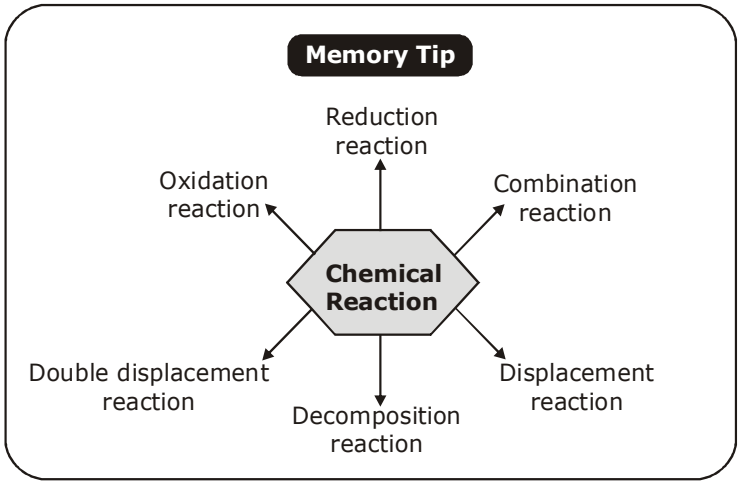
$Cl_2 + 2e^- \longrightarrow 2Cl^-$

Na is a reducing agent whereas Cl_2 is an oxidizing agent.

Example 6.



H_2S is a reducing agent whereas SO_2 is an oxidizing agent.



EFFECTS OF OXIDATION IN EVERYDAY LIFE

Oxidation has damaging effect on metals as well as on food. The damaging effect of oxidation on metals is studied as corrosion and that on food is studied as rancidity.

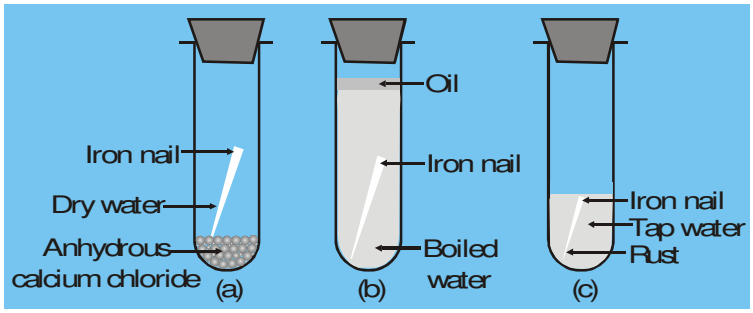
Thus there are two common effects of oxidation reactions are as

(I) Corrosion of metals **(II) Rancidity of food**

(I) **Corrosion of metals :–** Corrosion is the process of deterioration of metals as a result of its reaction with air, moisture and acids. (Present in environment) surrounding it.

The corrosion causes damage to buildings, bridges, ships and many other articles especially made of iron.

Rust : Iron corrode readily when exposed to moisture and gets covered with a brown flaky substance called rust. It is called rusting of iron, Rust is a hydrated Iron (III) oxide. [$\mathbf{Fe_2O_3 \cdot 2H_2O}$]



Rusting of iron takes place under the following conditions –

(a) Presence of air (or oxygen)

(b) Presence of water (or moisture) It has been observed that

(c) Presence of impurities in the metal speed up the rusting process. Pure iron does not rust.

(d) Presence of electrolytes in water also speeds up the process of rusting

(e) The position of the metal in the electrochemical series determines the extent of corrosion. More the reactivity of the metal, there will be more possibility of the metal getting corroded.

Other examples of corrosion are –

(i) Copper reacts with moist carbon dioxide in the air and slowly loses its shiny brown surface and acquires a green coating of basic copper carbonate.

(ii) Silver articles become black after sometime when exposed to air because it reacts with sulphur to form a coating of silver sulphide.

(iii) Lead or stainless steel lose their lusture due to corrosion.

(iv) Unreactive metals such as Gold, Platinum, Palladium, Titanium etc. do not corrode.

- **Prevention of Rusting.**

1. The iron articles should be painted.
2. The machine parts should be oiled and greased.
3. Galvanised iron pipes are used for water supply.
4. Iron can be coated with chromium to prevent rusting.

(II) **Rancidity.** The oxidation of oils or fats in food, resulting into a bad taste and bad smell is called rancidity. It is caused due to prolonged exposure of food in air. Oxygen present in air oxidise fats/oil present in food and form volatile substances, which have bad odour.

Do You Know?
Vitamin E and Vitamin C (Ascorbic acid) are the two antioxidants occuring in natural fats.

- **Prevention of rancidity :–**

(i) Rancidity can be prevented by adding antioxidants to foods containing fats and oils. Antioxidants are reducing agents so when they are added to food it do not get oxidised easily and hence do not turn rancid. The two common anti oxidants are **–**

(a) BHA (Butylated Hydroxy Anisole)

(b) BHT (Butylated Hydroxy Toluene)

(ii) Rancidity can be prevented by packaging fat and oil containing foods in nitrogen gas.

(iii) It can be retarted by keeping food in refrigerator.

(iv) It can also be retarded by storing food in air tight containers.

(v) It can be retarded by storing foods away from light.

SOLVED PROBLEMS

Ex.1 Translate the following statements into chemical equations and then balance them.

(A) Hydrogen gas combines with nitrogen to form ammonia

(B) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.

(C) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

(D) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Sol. (A) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

(B) $2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2$

from air

(C) $3BaCl_2(aq) + Al_2(SO_4)_3(aq) \longrightarrow 2AlCl_3(aq) + 3BaSO_4(s)$

White ppt.

(D) $2K(s) + 2H_2O(l) \longrightarrow 2KOH + H_2(g)$

Ex.2 Balance the following chemical equations.

(A) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$

(B) $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

Sol. (A) $2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + 2H_2O$

(B) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

Ex.3 Write the balanced chemical equations for the following reactions.

(A) Calcium hydroxide + Carbon dioxide $\longrightarrow$ Calcium carbonate + water

(B) Zinc + Silver nitrate $\longrightarrow$ Zinc nitrate + Silver

(C) Aluminium + copper chloride $\longrightarrow$ Aluminium chloride + Copper

(D) Barium chloride + Potassium sulphate $\longrightarrow$ Barium sulphate + Potassium chloride.

Sol. (A) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

calcium hydroxide — carbon dioxide — calcium carbonate

(B) $Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag$

zinc — silver nitrate — zinc nitrate — silver

(C) $2Al + 3CuCl_2 \longrightarrow 2AlCl_3 + 3Cu$

aluminium — copper chloride — aluminium chloride — copper

(B) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2KCl$

barium chloride — potassium sulphate — barium sulphate — potassium chloride

Ex.4 Write the balanced chemical equation for the following and identify the type of reaction in each case

(A) Potassium bromide(aq) + Barium iodide(aq) $\longrightarrow$ Potassium iodide(aq) + Barium bromide(s)

(B) Zinc carbonate (s) $\longrightarrow$ Zinc oxide (s) + Carbon dioxide(g)

(C) Hydrogen(g) + Chlorine(g) $\longrightarrow$ Hydrogen chloride(g)

(D) Magnesium(s) + Hydrochloridc acid(aq) $\longrightarrow$ Magnesium chloride(aq) + Hydrogen(g)

Sol. (A) $2KBr(aq) + BaI_2(aq) \longrightarrow 2KI(aq) + BaBr_2(aq)$

This reaction is a double-displacement reaction.

(B) $ZnCO_3(s) \longrightarrow ZnO(s) + CO_2(g)$

This reaction is a decomposition reaction

(C) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$ [Combination Reaction]

(D) $Mg(s) + 2HCl(aq.) \longrightarrow MgCl_2(aq.) + H_2(g)$ [Displacement Reaction]

Ex.5 Why should a magnesium ribbon be cleaned before burning in air?

Sol. Magnesium reacts with the constituent gases of the atmosphere to form various compounds which get deposited over its surface. The ribbon is cleaned before burning to remove the layer of these compounds so that pure magnesium can burn in air.

Ex.6 In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Sol. $2AgNO_3(aq) + Cu(s) \longrightarrow 2Ag(s) + Cu(NO_3)_2(aq)$

(silver nitrate) (copper) (silver metal) (copper(II) nitrate)

Ex.7 A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Sol. An element on heating in air changes in its oxide. The brownish element which forms black oxide is copper. So,

Name of the element Copper (Cu)

Name of black compound: Copper(II) oxide, (CuO)

Reaction $2Cu(s) + O_2(g) \xrightarrow{Heat} 2CuO(s)$

copper (brown) from air copper(II) oxide (black)

Ex.8 What happens chemically when quick lime is added or water ?

Sol. Calcium hydroxide (or slaked lime) is formed accompanied by a hissing sound. So much heat is evolved during the reaction that the reaction mixture starts boiling. The chemical equation for the reaction is :

$CaO(s) + H_2O(aq) \longrightarrow Ca(OH)_2(s) + \text{heat}$

(Quick lime) (Slaked lime)

Ex.9 What is an oxidation reaction ? Identify in the following reactions :

(i) the substance oxidised (ii) the substance reduced.

$$ZnO + C \longrightarrow Zn + CO$$

Sol. Oxidation involves the addition of oxygen or the removal of hydrogen in a chemical reaction while reduction involves the addition of hydrogen or removal of organ.

In the given reaction :

(i) Carbon (C) is oxidised to carbon monoxide (CO).

(ii) Zinc oxide (ZnO) is reduced to zinc (Zn)

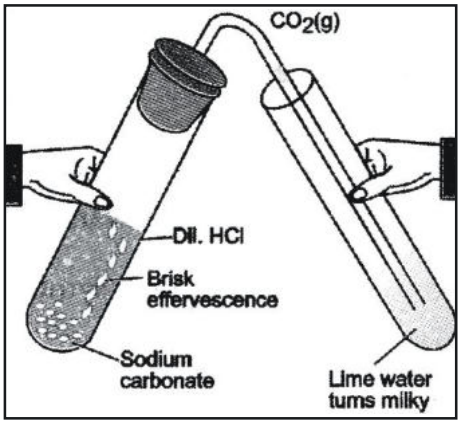
Ex.10 Which gas is evolved when dilute hydrochloric acid reacts with zinc ? Write the molecular formula of the gas.

Sol. Hydrogen gas is evolved. Its molecular formula is H_2.

Ex.11 State any two observation in an activity which may suggest that a chemical reaction has taken place. Give examples in support of your answer.

Sol. (i) In a tube take small amount of solid sodium carbonate (Na_2CO_3). To this add a few drops of hydrocloric acid.

(ii) A colourless and odourless gas will evolve which shows that a chemical reaction has taken place. The gas will turn lime water milky when passed through it.



Ex.12 Identify the type of reaction in the following examples :

(i) $Na_2SO_4(aq) + BaCl_2(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$

(ii) $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

(iii) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(\ell)$

Sol. (i) It is an example of double displacement reaction.

(ii) It is an example of displacement reaction.

(iii) It is an example of combination reaction.

Ex.13 Solid calcium oxide was taken in a container and water was added slowly to it

(i) State two observations made in the experiment.

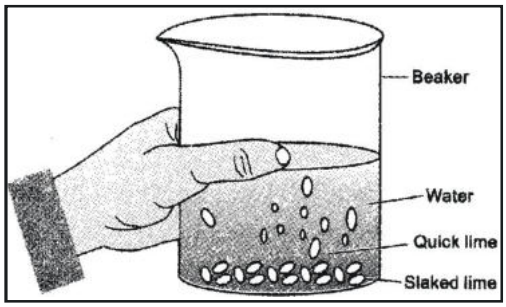
(ii) Write the name of the chemical formula of the product.

Sol. (i) Water will start boiling and hissing noise will be produced.

(ii) Calcium hydroxide (slaked lime) will be formed.

$CaO(s) + H_2O(aq) \longrightarrow Ca(OH)_2(s) + heat$

Calcium oxide Calcium hydroxide



Ex.14 A house wife wanted her house to be white washed. She bought 10 kg of quick lime from the market and dissolved in 30 litres of water. On adding lime to water, she noticed that the water started boiling even when it was not being heated. Give reason for her observation. Write the corresponding equation and name the product formed.

Sol. A supension of slaked lime also called calcium hydroxide is formed when water is added to quick lime.

$CaO(s) + H_2O(\ell) \longrightarrow Ca(OH)_2(s) + heat$

(Slaked lime)

Since the reaction is highly exothermic, the solution started although it was not being heated. The suspension of slaked lime is allowed to cool for sometime, preferably overnight. It is then decanted and the liquid obtained is used for white washing.

NCERT QUESTIONS WITH SOLUTIONS

Q.1 Why should a magnesium ribbon be cleaned before it is burnt in air?

Ans. Magnesium is an extremely reactive metal. When stored, it reacts with oxygen to form a layer of magnesium oxide on its surface. This layer of magnesium oxide is quite stable and prevents further reaction of magnesium with oxygen. The magnesium ribbon is cleaned by sand paper for removing this layer so that the underlying metal can be exposed to air.

Q.2 Write the balanced equation for the following chemical reactios.

(i) Hydrogen + Chlorine $\longrightarrow$ Hydrogen chloride

(ii) Berium chloride + Aluminium sulphate $\longrightarrow$ Barium sulphate + Aluminium chloride

(iii) Sodium + Water $\longrightarrow$ Sodium hydroxide + Hydrogen

Ans. (i) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$

(ii) $3BaCl_2(aq) + Al_2(SO_4)_3(aq) \longrightarrow 3BaSO_3(s) + 2AlCl_3(aq)$

(iii) $2Na(s) + 2H_2O(\ell) \longrightarrow 2NaOH(aq) + H_2(g)$

Q.3 Write a balanced chemical equation with state symbols for the following reactions.

(i) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride.

(ii) Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Ans. (i) $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$

(ii) $NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(\ell)$

Q.4 A solution of a substance 'X' is used for white washing.

(i) Name the substance 'X' and write its formula.

(ii) Write the reaction of the substance 'X' with water.

Ans. (i) The substance 'X' is calcium oxide. Its chemical foluma is CaO.

(ii) Calcium oxide reacts vigorously with water to form calcium hydroxide (slaked lime).

$CaO(s)$	+	$H_2O(\ell)$	$\longrightarrow$	$Ca(OH)_2(aq)$
Calcium oxide (Quick lime)		Water		Calcium hydroxide (Slaked lime)

Q.5 Why is the amount of gas collected in one of the test tubes is double of the amount collected in the other? Name this gas.

Ans. Water (H_2O) contains two parts hydrogen and one part oxygen. Therefore, the amount of hydrogen and oxygen produced during electrolysis of water is in a 2 : 1 ratio. During electrolysis, since hydrogen goes to one test tube and oxygen goes to another, the amount of gas collected in one of the test tubes is double of the amount collected in the other.

Q.6 Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Ans. When an iron nail is placed in a copper sulphate solution, iron displaces copper from copper sulphate solution forming iron sulphate, which is green in colour.

$Fe(s)$	+	$CuSO_4(aq)$	$\longrightarrow$	$FeSO_4(aq)$	+	$Cu(s)$
Iron		Copper sulphate (Blue colour)		Iron sulphate (Green colour)		Copper

Therefore, the blue colour of copper sulphate solution fades and green colour appears.

Q.7 Give an example of a double displacement reaction other than the one given in Activity 1.10.

Ans. Sodium carbonate reacts with calcium chloride to form calcium carbonate and sodium chloride.

$Na_2CO_3(aq)$ + $CaCl_2(aq)$ $\longrightarrow$ $CaCO_3(s)$ + $2NaCl(aq)$

Sodium carbonate — Calcium chloride — Calcium carbonate — Sodium chloride

In this reaction, sodium carbonate and calcium chloride exchange ions to form two new compounds. Hence, it is a double displacement reaction.

Q.8 Identify the substances that are oxidised and the substances that are reduced in the followiing reactions.

(i) $4Na(s)$ + $O_2(g)$ $\longrightarrow$ $2Na_2O(s)$ + $O_2(g)$

(ii) $CuO(s)$ + $H_2(g)$ $\longrightarrow$ $Cu(s)$ + $H_2O(\ell)$

Ans. (i) Sodium (Na) is oxidised as it gains oxygen and oxygen gets reduced.

(ii) Copper oxide (CuO) is reduced to copper (Cu) while hydrogen (H_2) gets oxidised to water (H_2O).

Q.9 Which of the statements about the reaction below are incorrect?

$2PbO(s)$ + $C(s)$ $\longrightarrow$ $2Pb(s)$ + $CO_2(g)$

(a) Lead is getting reduced.

(b) Carbon dioxide is getting oxidised.

(c) Carbon is getting oxidised.

(d) Lead oxide is getting reduced.

(1) (a) and (b) (2) (a) and (c) (3) (a), (b) and (c) (4) all

Ans. (1) (a) and (b)

Q.10 Fe_2O_3 + $2Al$ $\longrightarrow$ Al_2O_3 + $2Fe$

The above reaction is an example of a

(1) Combination reaction. (2) Double displacement reaction.

(3) Decomposition reaction. (4) Displacement reaction.

Ans. (4) The given reaction is an example of a displacement reaction.

Q.11 What happens when dilute hydrochloric add is added to iron filings? Tick the correct answer.

(1) Hydrogen gas and iron chloride are produced.

(2) Chlorine gas and iron hydroxide are produced.

(3) No reaction takes place.

(4) Iron salt and water are produced.

Ans. (1) Hydrogen gas and iron chloride are produced. The reaction is as follows:

$Fe(s)$ + $2HCl(aq)$ $\longrightarrow$ $FeCl_2(aq)$ + $H_2\uparrow$

Q.12 What is a balanced chemical equation? Why should chemical equations be balanced ?

Ans. A reaction which has an equal number of atoms of all the elements on both sides of the chemical equation is called a balanced chemical equation. The law of conservation of mass states that mass can neither be created nor destroyed. Hence, in a chemical reaction, the total mass of reactants should, be equal to the total mass of the products. It means that the total number of atoms of each element should be equal on both sides of a chemical equation. Hence, it is for this reason that chemical equations should be balanced.

Q.13 Translate the following statements into chemical equations and then balance them.

(a) Hydrogen gas combines with nitrogen to form ammonia.

(b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.

(c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

(d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Ans. (a) $3H_2(g) + N_2(g) \longrightarrow 2NH_3(g)$

(b) $2H_2S(g) + 3O_2(g) \longrightarrow 2H_2O(\ell) + 2SO_2(g)$

(c) $3BaCl_2(aq) + Al_2(SO_4)_3(aq) \longrightarrow 2AlCl_3(aq) + 3BaSO_4(s)$

(d) $2K(s) + 2H_2O(\ell) \longrightarrow 2KOH(aq) + H_2(g)$

Q.14 Balance the following chemical equations.

(a) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$

(b) $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

(c) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(d) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Ans. (a) $2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2(g)$

(b) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(c) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(d) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Q.15 Write the balanced chemical equations for the following reactions.

(a) Calcium hydroxide + Carbon dioxide $\longrightarrow$ Calcium carbonate + Water

(b) Zinc + Silver nitrate $\longrightarrow$ Zinc nitrate + Silver

(c) Aluminium + Copper chloride $\longrightarrow$ Alumiium chloride + Copper

(d) Barium chloride + Potassium sulhate $\longrightarrow$ Barium sulphate + Potassium chloride

Ans. (a) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

(b) $Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag$

(c) $2Al + 3CuCl_2 \longrightarrow 2AlCl_3 + 3Cu$

(d) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2KCl$

Q.16 Write the balanced chemical equation for the following and identify the type of reaction in each case.

(a) Potassium iodide(aq) + Barium iodide(aq) $\longrightarrow$ Carbon dioxide(g)

(b) Zinc carbonate(s) $\longrightarrow$ Zinc oxide(s) + Carbon dioxide(g)

(c) Hydrogen(g) + Chlorine(g) $\longrightarrow$ Hydrogen chloride(g)

(d) Magnesium(s) + Hydrochloric acid(aq) $\longrightarrow$ Magnesium chloride(aq) + Hydrogen(g)

Ans. (a) $2KBr(aq) + BaI_2(aq) \longrightarrow 2KI(aq) + BaBr_2(s)$; Double displacement reaction

(b) $ZnCO_3(s) \longrightarrow ZnO(s) + CO_2(g)$; Decomposition reaction

(c) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$; Combination reaction

(d) $Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$; Displacement reaction

Q.17 What does one mean by exothermic and endothermic reactions? Give examples.

Ans. Chemical'reactions that release energy in the form of heat, light, or sound are called exothermic reaction.

Example: Mixture of sodium and chlorine to yield table salt

$$Na(s) + \frac{1}{2}Cl_2(g) \longrightarrow NaCl(s) + 411 \text{ kL of energy}$$

In other words, combination reactions are exothermic.

Reactions that absorb energy or require energy in order to proceed are called endothermic reactions. For example: In the process of photosynthesis, plants use the energy from the sun to convert carbon dioxide and water to glucose and oxygen.

$$6CO_2(g) + 6H_2O(\ell) \xrightarrow{\text{Sunlight}} C_6H_{12}O_6(aq) + 6)_2(g$$

Glucose

Q.18 Why is respiration considerd an exothermic reaction ? Explain.

Ans. Energy is required to support life. Energy in our body is obtained from the food we eat. During digestion, large molecules of food are broken down into simpler substances such as glucose. Glucose combines with oxygen in the cells and provides energy. The special name of this combustion reaction is respiration. Since energy is released in the whole process, it is an exothermic process.

$$\underset{\text{Glucose}}{C_6H_{12}O_6(aq)} + \underset{\text{Oxygen}}{6O_2(g)} \longrightarrow \underset{\text{Carbon dioxide}}{6CO_2(g)} + \underset{\text{Water}}{6H_2O(\ell)} + \text{Energy}$$

Q.19 Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Ans. Decomposition reactions are those in which a compound breaks down to form two or more substances. These reactions require a source of energy to proceed. Thus, they are the exact opposite of combination reactions in which two or more substances combine to give a new substance with the release of energy.

Decomposition reaction: $AB + \text{Energy} \longrightarrow A + B$

$$2H_2O(\ell) \xrightarrow{\text{Electrolysis}} 2H_2(g) + O_2(g)$$

Combination reaction: $A + B \longrightarrow AB + \text{Energy}$

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(\ell) + \text{Energy}$$

Q.20 Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

Ans. (a) Thermal decomposition:

$$\underset{\text{Ferrous sulphate}}{2FeSO_4(s)} \xrightarrow{\Delta} \underset{\text{Ferric oxide}}{Fe_2O_3(g)} + \underset{\text{Sulphur dioxide}}{SO_2(g)} + \underset{\text{Sulphur trioxide}}{SO_3(g)}$$

(b) Decomposition by light:

$$\underset{\text{Silver chloride}}{2AgCl(s)} \xrightarrow{\text{Light}} \underset{\text{Silver}}{2Ag(s)} + \underset{\text{Chlorine}}{Cl_2(s)}$$

(c) Decomposition by electricity:

$$\underset{\text{Aluminium oxide}}{2Al_2O_3(aq)} \xrightarrow{\text{Electricity}} \underset{\text{Aluminium}}{4Al(s)} + \underset{\text{Oxygen}}{3O_3(g)}$$

Q.21 What is the difference betuJeen dispiacemen[and double displacement reactions? Write equations for these reactions.

Ans. In a displacement reaction, a more reactive element replaces a less reactive element from a compound.

$A + BX \longrightarrow AX + B$; where A is more reactive than B

In a double displacement reaction, two atoms or a group of atoms shift places to form new compounds.

$AB + CD \longrightarrow AD + CB$

For example:

Displacement reaction:

$CuSO_4(aq) + Zn(s) \longrightarrow ZnSO_4(aq) + Cu(s)$

Double displacement reaction:

$Na_2SO_4(aq) + BaCl_2(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$

Q.22 In the refining of silver, the recovery of silver from silver nitrate solutior. involved displacement by copper metal. Write down the reaction involved.

Ans.

$2AgNO_3(aq)$	+	$Cu(s)$	$\longrightarrow$	$Cu(NO_3)_2(aq)$	+	$2Ag(s)$
Silver nitrate		Copper		Copper nitrate		Silver

Q.23 What do you mean by a precipitation reaction? Explain by giving examples.

Ans. A reaction in which an insoluble solid (called precipitate) is formed is called a precipitation reaction.

For example:

$Na_2CO_3(aq)$	+	$CaCl_2(aq)$	$\longrightarrow$	$CaCO_3(s)$	+	$2NaCl(aq)$
Sodium carbonate		Calcium chloride		Calcium carbonate		Sodium chloride

In this reaction, calcium carbonate is obtained as a precipitate. Hence, it is a precipitation reaction.

Another example of precipitation reaction is:

$Na_2SO_4(aq)$	+	$BaCl_2(aq)$	$\longrightarrow$	$BaSO_4(s)$	+	$2NaCl(aq)$
Sodium sulphate		Barium chloride		Barium sulphate		Sodium chloride

In this reaction, barium sulphate is obtained as a precipitate.

Q.24 Explain the following in terms of gain or loss of oxygen with two examples each.

(a) Oxidation (b) Reduction

Ans. (a) Oxidation is the gain of oxygen.

For example:

(i) $CO_2 + \underbrace{H_2 \longrightarrow}_{\text{Addition of oxygen-oxidation}} CO + H_2O$

(ii) $\underbrace{2Cu + O_2 \longrightarrow}_{\text{Gain of oxygen - oxidation}} {}_2C_uO$

In equation (i), H_2 is oxidized to H_2O and in equation (ii), Cu is oxidised to CuO.

(b) Reduction is the loss of oxygen.

For example:

(i) $\underbrace{CO_2 + H_2 \longrightarrow}_{\text{Removal of oxygen - reduction}} CO + H_2O$

(ii) $\underbrace{CuO + H_2 \xrightarrow{\Delta}}_{\text{Loss of oxygen - reduction}} Cu + H_2O$

in equation (i), CO_2 is reduced to CO and in equation (ii), CuO is reduced ro Cu.

Q.25 A shiny brown-cloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Ans. 'X' is copper (Cu) and the black-coloured ocmpound formed is copper oxide (CuO). The equation of the reaction involved on heating copper is given below.

$$2Cu + O_2 \xrightarrow{Heat} 2CuO$$

(Shiny brown in colour) (Black in colour)

Q.26 Why do we apply paint on iron articles?

Ans. Iron articles are painted because it prevents them from rusting. When painted, the contact of iron articles from moisture and air is cut off. Hence, rusting is prevented. Their presence is essential for rusting to take place.

Q.27 Oil and fat containing food items are flushed with nitrogen. Why?

Ans. Nitrogen is an inert gas and does not easily read with these substances. On the other hand, oxygen reacts with food substances and makes them rancid. Thus, bags used in packing food items are flushed with nitrogen gas to remove oxygen inside the pack. When oxygen is not present inside the pack, rancidity of oil and fat containing food items is avoided.

Q.28 Explain the following terms with one example each.

(a) Corrosion (b) Rancidity

Ans. **(a) Corrosion:** Corrosion is defined as a process where materials, usually metals, deteriorate as a result of a chemical reaction with air, mOisture, chemicals, etc.

For example, iron, in the presence of moisture, reacts with oxygen to form hydrated iron oxide.

$$4Fe + 3O_2 + nH_2O \longrightarrow 2Fe_2O_3.nH_2O$$

Hydrated iron oxide

This hydrated iron oxide is rust.

(b) Rancidity: The process of oxidation of fats and oils that can be easily noticed by the change in taste and smell is known as rancidity.

For example, the taste and smell of butter changes when kept for long.

Rancidity can be avoided by:

(1) Storing fooo in air tight containers

(2) Storing fooo in refrigerators

(3) Adding antioxidants

(4) Storing food in an environment of nitrogen

EXERCISE-I

Type I- Very Short Answer Questions

Q.1 Why does not a wall immediately acquire a white colour when a coating of slaked lime is applied on it? **[C.B.S.E. 2010]**

Q.2 What is ruet?

Q.3 What is the difference b/w the following 2 reactions? **[C.B.S.E. 2011]**
(a) $Mg + 2HCl \longrightarrow MgCl_2 + H_2$
(b) $NaOH + HCl \longrightarrow NaCl + H_2O$

Q.4 Suggest 2 ways to check the rancidity of food articles. **[C.B.S.E. 2011, 2012]**

Q.5 What is the role of oxidising agent in a reaction? **[C.B.S.E. 2010]**

Q.6 What is meant by a skeletal chemical equation? **[C.B.S.E. 2010]**

Q.7 On what basis is a chemical equation balanced? **[C.B.S.E. 2010]**

Q.8 Balance following chemical equation:-
$Pb(NO_3)_2(s) \xrightarrow{Heat} Pbo(s) + NO_2(g) + O_2(g)$
[C.B.S.E. 2009]

Q.9 Write a balanced chemical equation to represent the following equation:- Iron reacts with stream to form Iron (II, III) oxide and Hydrogen gas.**[C.B.S.E. Sample paper 2011]**

Q.10 Balance the following chemical equation.
(i) $FeCl_2 + H_2S \longrightarrow HCl + Fes$
(ii) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$
[C.B.S.E. 2008]

Q.11 What happens chemically when Quick lime is added to water? **[C.B.S.E. 2010]**

Q.12 Give one example of each exothermic reaction and endothermic reaction? **[C.B.S.E. 2010]**

Q.13 What is the brown coloured gas evolved when lead nitrate crystals are heated in a dry test tube? **[C.B.S.E. 2010]**

Q.14 In the reaction $MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$. Identify which one is reduced and which one is oxidized? **[C.B.S.E. 2010]**

Q.15 Complete the equation:- **[C.B.S.E. 2010]**
$Fe_2O_3 + 2Al \longrightarrow$

Q.16 Take a small amount of calcium oxide or quick lime in a beaker and slowly add water to this. Is there any change in temperature?
[C.B.S.E. 2010, 2011]

Q.17 Which chemical process is used for obtaining a metal from its oxide? **[C.B.S.E. 2010]**

Type II - Short Answer Type Questions

Q.18 Write balance chemical equation "during respiration combustion of glucose takes place producing carbon dioxide water and energy".

Q.19 A zinc rod is left for nearly 20 minutes in a copper sulphate solution. What change would you observe in zinc rod?

Q.20 Name a reducing agent that can be used to obtain manganese from manganese dioxide. Write balanced chemical equation for the reaction? **[C.B.S.E. Delhi 2009]**

Q.21 Give reason, silver articles become black after sometime when exposed to air?
[C.B.S.E. 2008]

Q.22 What is the role of catalyest in a chemical reaction? **[C.B.S.E. 2007]**

Q.23 Name 2 salts which are used in black and white photography? **[C.B.S.E. 2010, 11]**

Q.24 State the essential requriement for rusting?
[C.B.S.E. 2013]

Type III- Long Answer Type Questions

Q.25 When a water insoluble substance "X" is added to dil. Hydrochloric acid, a colourless, odourless gas is evolved. When the gas is passed through lime water, it turns milky. Write the formula of gas evolved and balanced chemical equation of the reaction.

Q.26 **(a)** Write one equation each for decomposition reaction when energy is supplied in the form of (i) Heat (ii) Light.

(b) Account for following:-

(i) Paint is applied on Iron articles.

(ii) Oil and fat containing food items are flushed with nitrogen. **[C.B.S.E. 2011]**

Q.27 A green coloured hydrated salt of Iron loses its water of crystallisation and smell of burning sulphur is given. Identify the salt and write chemical equation. **[C.B.S.E. 2011]**

Q.28 (a) Why cannot a chemical change be normally reversed?

(b) Why is it always essential to balance a chemical equation?

(c) Why do diamond and graphite, 2 forms of carbon evolve different amounts heat on combustion?

(d) Why does milkness disappear when CO_2 is passed throug lime water in excess?

(e) Can rusting of Iron take place in distilled water?

Q.29 $X + YSO_4 \longrightarrow XSO_4 + Y$

$Y + XSO_4 \longrightarrow$ No reaction

and of the 2 elements "X" and "Y" which is more reactive and why? **[C.B.S.E. 2011]**

Q.30 (a) Can a combination reaction be an oxidation reaction? **[C.B.S.E. 2011]**

(b) How will you test whether the gas evolved in a reaction is hydrogen?

(c) Why does copper not evolve hydrogen on reacting with dilute sulphuric acid?

Q.31 A brown substance "X" on heating in air forms a substance "Y". When hydrogen gas is passed over heated "Y". It again changes back into "X". **[C.B.S.E. 2010]**

(i) Name the substance X and Y.

(ii) Name the chemical processes occuring during both changes.

(iii) Write chemical equations?

Q.32 Explain why:- **[C.B.S.E. 2011]**

(i) Respiration is an Exothermic reaction.

(ii) When blue salt of $CuSO_4$ is heated it becomes colourless?

Q.33 In electrolysis of water **[C.B.S.E. 2012]**

(i) Name the gas collected at the cathod and anode respectively.

(ii) Why is the volume of one gas collected at one electrode double that at the other? Name this gas?

(iii) How will you test the evolved gases?

Q.34 Identify the type of reaction **[C.B.S.E. 2012]**

(i) $CuSO_4 + Zn \longrightarrow ZnSO_4 + Cu$

(ii) $BaCl_2 + ZnSO_4 \longrightarrow BaSO_4 + ZnCl_2$

(iii) $NH_4Cl \xrightarrow{Heat} NH_3 + HCl$

(iv) $HgCl_2 + SnCl_2 \longrightarrow HgCl_2 + SnCl_4$

(v) $2KClO_3 \longrightarrow Al_2O_4 + 2Fe$

(vi) $2All + Fe_2O_3 \longrightarrow Al_2O_3 + 2Fe$

Q.35 Balance the following equation **[C.B.S.E. 2008]**

(i) $H_2SO_4(aq.) + NaOH(aq.) \longrightarrow Na_2SO_4(aq.) + H_2O\ (l)$

(ii) $KCN(aq.) + H_2SO_4(aq.) \longrightarrow K_2SO_4(aq.) + HCN(g)$

(iii) $HgCl_2 + SnCl_2 \longrightarrow Hg_2Cl_2 + SnCl_4$

(iv) $Al_2O_3 + H_2SO_4 \longrightarrow Al_2(SO_4)_3 + H_2SO_4$

(v) $Al_{2(}SO_4)_3 + NaOH \longrightarrow Al(OH)_3 + Na_2SO_4$

Q.36 Identify the type of reaction

(i) $2H_2O \xrightarrow{\text{Electrolysis}} 2H_2 + O_2$

(ii) $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$

(iii) $AgNO_3 + Nacl \longrightarrow NaNO_3 + Agcl$

(iv) $Zn(s) + 2AgNO_3(aq.) \longrightarrow Zn(NO_3)_2(aq.) + 2Ag(s)$

(v) $Ni(NO_3)_2(aq.) + 2NaOH(aq.) \longrightarrow Ni(OH)_2 \downarrow + 2NaNO_3(aq.)$

(vi) $MgO(s) + C(s) \longrightarrow CO(g) + Mg(s)$

Type IV- Thinking Based/Skill Based Questions

Q.37 The marble statues slowly get carroded when kept in open for a long time. Give suitable explanation?

Q.38 **(a)** Based on reactions given below, arrange the metals invloved in these reactions in decreasing order of reactivity. Give suitable explanation.

(i) $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

(ii) $Cu + 2AgNO_3 \longrightarrow Cu(NO_3)_2 + 2Ag$

(i) $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$

(ii) $FE + CuSO_4 \longrightarrow FeSO_4 + Cu$

(b) What is the nature of reactions?

Q.39 A, B and C are 3 elements which undergo chemical reactions according to following equations:-

$A_2O_3 + 2B \longrightarrow B_2O_3 + 2A$

$3CSO_4 + 2B \longrightarrow B_2(SO_4)_3 + 3C$

$3CO + 2A \longrightarrow A_2O_3 + 3C$

Ans. Following Questions

(a) Which element is more reactive?

(b) Which element is least reactive?

Q.40 You are given following materials:-

(i) Marble chips (ii) Dil. HCl acid (iii) zinc granules

Identify type of reaction when marble chips and zinc granules are added separately to acid taken in two tubes. Write chemical equation in each case.

Q.41 2gm of $FeSO_4$ Crystals were heated in a hard glass test tube and observations recorded.

(a) What was the successive colour change?

(b) Identify liquid droplets collected on cooler part of test tube.

(c) What type of odour is observed on heating $FeSO_4$ Crystals?

EXERCISE-II

SECTION-A

1. **Fill in the blanks**

1. The compound $YBa_2Cu_3O_7$, which shows superconductivity, has copper in oxidation state _____ assume that the rare earth element yttrium is in its usual +3 oxidation state.
2. The oxidation number of carbon in CH_2O is _____.
3. The brown ring complex compound in formulated as $[Fe(H_2O)_5(NO)^+]SO_4$. The oxidation number of iron is _____.
4. The oxidation number of phosphorus in $Ba(H_2PO_2)_2$ is: _____.
5. The oxidation number of sulphur in S_8, S_2F_2, H_2S respectively are _____.

2. Balance the following equation by ion-electron method.

1. MnO_4^- (aq) + I^- (aq) $\longrightarrow$ MnO_2 (s) + I_2 (s) (In basic medium)
2. MnO_4^- (aq) + SO_2 (g) $\longrightarrow$ Mn^{2+} (aq) + HSO_4^- (aq) (In acidic medium)
3. H_2O_2 (aq) + Fe^{2+} (aq) $\longrightarrow$ Fe^{3+} (aq) + H_2O (*l*) (In acidic medium)
4. $Cr_2O_7^{2-}$ (aq) + SO_2 (g) $\longrightarrow$ Cr^{3+} (aq) + SO_4^{2-} (aq) (In acidic medium)
5. $H_2S + HNO_3 \longrightarrow H_2SO_4 + NO_2 + H_2O$
6. $NO_3^- + Bi \longrightarrow Bi^{3+} + NO_2$ (in acidic medium)
7. $Al + NO_3^- \longrightarrow Al(OH)_4^- + NH_3$ (in basic medium)

3. Find the oxidation number or oxidation state of underlined elements.

(i) $\underline{C}H_2O$ (ii) $\underline{Mg}_3N_2$ (iii) $\underline{N}H_2OH$ (iv) $\underline{I}Cl_3$

(v) $K\underline{O}_2$ (vi) $H_2\underline{S}_2O_8$

SECTION-B

- **Multiple choice question with one correct answers**

1. A reaction in which, under equilibrium conditions, both the reactants and products are present is called,
   (A) reversible (B) Irreversible (C) endothermic (D) exothermic
2. The reaction, $H_2 + Cl_2 \longrightarrow 2HCl$ is,
   (A) an oxidation reaction (B) a reduction reaction
   (C) a combination reaction (D) an isomoerisation reaction
3. When sodium metal is dropped into water, it gets
   (A) oxidised (B) reduced (C) remain unchanged (D) hydrolysed
4. Fatty foods become rancid because of which one of the following?
   (A) Oxidation (B) Reduction (C) Hydrogenation (D) Corrosion
5. Which one of the following reactions is an example of thermal decomposition?
   (A) $CaCO_3$ (s) $\longrightarrow$ CaO (s) + CO_2 (g) (B) 2HOCl (aq) $\longrightarrow$ O_2 (g) + HCl (g)
   (C) 2AgCl (I) $\longrightarrow$ 2Ag (s) (g) + Cl_2 (g) (D) $2H_2O$ (I) $\longrightarrow$ $2H_2$ (g) + O_2 (g)
6. In the reaction $2Al + Fe_2O_3 \longrightarrow Al_2O_3 + 2Fe$ which one is oxidized?
   (A) Al (B) Fe (C) Fe_2O_3 (D) none
7. Oily and fatty food items are flushed with nitrogen gas because of which one of the following reasons?
   (A) Nitrogen reacts with oils and fats and thus prevents oxidation
   (B) Nitrogen is inert and excludes a direct contact of air with oily and fatty food items

(C) Nitrogen helps in the decomposition of food items and makes them tasty.
(D) The given statements is wrong.

8. Which one of the following is used in the white washing of walls?
(A) Calcium oxide mixed with water (B) Calcium carbonate mixed with water
(C) Calcium sulphate mixed with water (D) Sodium chloride mixed with water

9. Dissolving sugar in water is an example of:
(A) Physical change (B) Chemical change (C) Redox reaction (D) None of these

10. Heat is evolved during:
(A) Endothermic reaction (B) Displacement reaction
(C) Combustion reaction (D) Combination reaction

11. In an electroytic cell where electrolysis is carried, anode has:
(A) Positive charge
(B) Negative charge
(C) Connected to negative terminal of the battery
(D) None of these is correct

12. A change is said to be a chemical change when:
(A) energy change occurs (B) new substances are formed
(C) the change cannot be easily reversed (D) all statements are correct

13. Copper displaces which of the following metals from its salt solution:
(A) $ZnSO_4$ (B) $FeSO_4$ (C) $AgNO_3$ (D) $NiSO_4$

14. Which of the following is an example of displacement reaction?
(A) $2KClO_3 \longrightarrow 2KCl + 3O_2$ (B) $2H_2 + O_2 \longrightarrow 2H_2O$
(C) $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$ (D) $N_2 + 3H_2 \longrightarrow 2NH_3$

15. A redox reaction is one in which :
(A) both the substances are reduced
(B) both are the substances are oxidised
(C) an acid is neutraliesd by the base
(D) one substance is oxidised while the other is reduced

SECTION-C

- **Assertion & Reason**

Instructions: In the following questions as Assertion (A) is given followed by a Reason (R). Mark your responses from the following options.

(A) Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'
(B) Both Assertion and Reason are true and Reason is not the correct explanation of 'Assertion'
(C) Assertion is true but Reason is false
(D) Assertion is false but Reason is true

1. **Assertion:** In $HClO_3$ oxidation number of Cl is -1.
Reason: Oxygen is more electropositive then fluorine.

2. **Assertion:** Oxidation state of carbon in its compounds is some time +4.
Reason: An element has a fixed **oxidation** state.

SECTION-D

- **Match the following (one to one)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. Only One entries of column-I may have the matching with the same entries of column-II and one entry of column-II Only one matching with entries of column-I.

(Match the oxidation state of the underlined elements.)

1.

Column I	**Column II**
(A) $\underline{Xe}F_4$	(P) –3
(B) $\underline{N}H_4^+$	(Q) +4
(C) $\underline{Xe}O_2F_2$	(R) +5
(D) $Na_3\underline{P}O_4$	(S) +6

EXERCISE-III

SECTION-A

- **Multiple choice question with one correct answers**

1. In the reaction, $H_2S + Cl_2 \longrightarrow 2HCl + S$, the electrons are transfered from,
   (A) S^{2-} to S (B) Cl_2 to HCl (C) S^{2-} to Cl_2 (D) H_2S to S
2. Which one of the following is not double displacment reaction?
   (A) $Pb(NO_3)_2$ (aq) + 2KI (aq) $\longrightarrow PbI_2$ (s) + $2KNO_3$ (aq)
   (B) $CuSO_4$ (aq) + H_2S (aq) $\longrightarrow$ CuS (s) + H_2SO_4 (aq)
   (C) Na_2CO_3 (s) + 2HCl (aq) $\longrightarrow$ 2NaCl (aq) + H_2CO_3 (aq)
   (D) CaO (s) + CO_2 (g) $\longrightarrow CaCO_3$ (s)
3. Which one of the following reactions is an example of photodecomposition?
   (A) $CaCO_3$ (s) $\longrightarrow$ CaO (s) + CO_2 (g) (B) NH_4Cl (s) $\longrightarrow NH_3$ (g) + HCl (g)
   (C) $2H_2O$ (I) $\longrightarrow 2H_2$ (g) + O_2 (g) (D) 2AgCl (s) $\longrightarrow$ 2Ag (s) + Cl_2 (g)
4. Which one of the following reactions is an example of electrical decomposition?
   (A) $CaCO_3$ (s) $\longrightarrow$ CaO (s) + CO_2 (g) (B) 2HOCl (aq) $\longrightarrow O_2$ (g) + HCl (g)
   (C) $2H_2O$ (I) $\longrightarrow 2H_2$ (g) + O_2 (g) (D) 2AgCl (s) $\longrightarrow$ 2Ag (s) + Cl_2 (g)
5. A shiny - brown substance X on heating in air turns black and a new compound Y is formed. Name the substance X and black compound Y.
   (A) X = Fe and Y = FeO (B) X = Cu and Y = $Cu(OH)_2$
   (C) X = Cu and Y = CuO (D) X = Al and Y = AlO_3
6. A substance which oxidises itself and reduces other is known as:
   (A) Oxidising agent (B) Reducing agent (C) Both of these (D) None of these
7. The reaction between lead nitrate and potassium iodide present in aqueous solutions is an example
   (A) Decomposition reaction (B) Displacement reaction
   (C) Double displacement (D) Neutralisation reaction
8. Oxidation is a process which involves
   (A) Addition of oxygen (B) Removal of hydrogen
   (C) Loss of electrons (D) All are correct
9. Aluminium oxide reacts with sulphuric acid to form
   (A) Aluminium sulphate and hydrogen (B) Aluminium sulphate and oxygen
   (C) Aluminium suphate and water (D) Aluminium sulphate and sulphur dioxide
10. Chemically rust is:
    (A) hydrated ferrous oxide (B) hydrated ferric oxide
    (C) only ferric oxide (D) none of these

SECTION-B

- **Multiple choice question with one or more than one correct answers**

1. In the reaction,

   $P_4 \longrightarrow H_2PO_2^- + PH_3$ (Alkaline medium)

   which statement is correct

   (A) P_4 is oxidized (B) It is a decomposition reaction

   (C) P_4 is reduced (D) It is not a redox reaction

2. Which of the following can act both as oxidising agent and reducing agents?

   (A) HNO_2 (B) H_2O_2 (C) H_2S (D) SO_2

3. In the reaction:

   $2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$

   (A) $S_2O_3^{2-}$ gets reduced to $S_4O_6^{2-}$ (B) $S_2O_3^{2-}$ gets oxidised to $S_4O_6^{2-}$

   (C) I_2 gets reduced to I^- (D) I_2 gets oxidised to I^-

4. When a chemical species loses one or more electrons, it is said to have been

   (A) oxidised (B) reduced (C) decomposed (D) act as reducing agent

5. Which statements are correct for the reaction $CuO + H_2 \longrightarrow Cu + H_2O$

   (A) CuO is reduced (B) H_2 is oxidized

   (C) CuO is reduced and H_2 is oxidized (D) Both CuO and H_2 are oxidized

6. Which of the following is not balanced equation?

   (A) $Fe + Cl_2 \longrightarrow FeCl_3$ (B) $Mg + CuSO_4 \longrightarrow MgSO_4 + Cu$

   (C) $NaOH + HCl \longrightarrow NaCl + H_2O$ (D) $N_2O_3 \longrightarrow N_2 + 3O_2$

7. Which of the following reactions is not correct?

   (A) $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$ (B) $2Ag + Cu(NO_3)_2 \longrightarrow 2AgNO_3 + Cu$

   (C) $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$ (D) $Cu + H_2SO_4 \longrightarrow CuSO_4 + H_2$

8. In the reaction $PbO + C \longrightarrow Pb + CO$

   (A) PbO is reduced (B) C acts as an oxidising agent

   (C) C acts as a reducing agent (D) This reaction does not represent redox reaction

9. In the reaction:

   $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$

   (A) Zn gets oxidised (B) Fe gets reduced

   (C) Zn is an oxidising agent (D) Zn and Fe are both oxidised

10. Which of the following are example of decomposition reaction?

    (A) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

    (B) $Ca(OH)_2(s) \longrightarrow CaO + H_2O(l)$

    (C) $CuSO_4 . 5H_2O(s) \longrightarrow CuSO_4(s) + 5H_2O(g)$

    (D) $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$

SECTION-C

Comprehensions

Passage-1

Oxidation number is the charge assigned to an atom of a molecule or ion according to some arbitrary rules. In neutral molecules, the sum of the oxidation numbers of all the atoms present is zero while in a simple or complex ion it is equal to the net charge on ion. In some cases, the oxidation number may be even fractional. Although sometimes, a particular element may have same valency and oxidation state but these are based upon different concepts. The number of oxidation states available for a particular

element are normally more than the valencies.

1. A brown complex has the formula:
   $[Fe(H_2O)_5NO]SO_4$. The oxidation number of iron is:
   (A) +1 (B) +2 (C) +3 (D) 0
2. In which compound, Mn exhibits highest oxidation state?
   (A) MnO_2 (B) Mn_3O_4 (C) K_2MnO_4 (D) $MnSO_4$
3. In which of the following pairs, there is the maximum difference in the oxidation state of the underlined elements?
   (A) $\underline{N}O_2$ and $\underline{N}_2O_4$ (B) $\underline{P}_2O_5$ and $\underline{P}_4O_{10}$ (C) $\underline{N}_2O$ and $\underline{N}O$ (D) $\underline{S}O_2$ and $\underline{S}O_3$

Passage-2

A redox reaction consists of oxidation and reduction half reactions. There is a loss of electrons in oxidation and the species which loses electrons is reducing agent. Its oxidation number increases during oxidation. Similarly there is a gain of electrons during reduction and the species which gains reduction and the species which gains electrons is an oxidising agent. Its oxidation number decreases during reduction. The number of electrons released during oxidation is equal to number of electrons gained during reduction.

1. The reaction:
   $2H_2O\ (l) \longrightarrow 4H^+\ (aq) + O_2 + 4e^-$
   (A) an oxidation reaction (B) a reduction reaction
   (C) a redox reaction (D) a hydrolysis reaction
2. Which of the following involves transfer of five electrons?
   (A) $(MnO_4)^- \longrightarrow Mn^{2+}$ (B) $(CrO_4)^{2-} \longrightarrow (Cr)^{3+}$
   (C) $(MnO_4)^{2-} \longrightarrow MnO_2$ (D) $(Cr_2O_7)^{2-} \longrightarrow 2Cr$
3. In $I_2 \rightarrow I^- + IO_3^{-1}$ alaklyne medium
   (A) 0 to –1 & 0 to +5 (B) 5 to –1 & o to –5
   (C) –5 to 0 & 0 to –1 (D) –7 to –1 & 0 to +7

SECTION-D

- **Match the following (one to many)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may have the matching with the same entries of column-II and one entry of column-II may have one or more than one matching with entries of column-I

1.

Column I	**Column II**
(A) Double displacment	(P) $CuO + H_2 \xrightarrow{heat} Cu + H_2O$
(B) Decomposition	(Q) $Na_2SO_4\ (aq) + BaCl_2\ (aq) \longrightarrow BaSO_4\ (aq) + 2NaCl\ (aq)$
(C) Precipitation	(R) $CaCO_3 \xrightarrow{heat} CaO + CO_2$
(D) Redox	(S) $NaOH + HCl \rightleftharpoons NaCl + H_2O$

EXERCISE-IV(For Olympiad)

Q.1 The example of a physical change is
(A) milk is left at room temperature in summers
(B) an Iron is heated
(C) Iron tawa is left emposed to humid air
(D) Food is cooked

Q.2 Which of the following is/are exothermic processes
(i) Sublimation of NH_4Cl
(ii) Quick lime is added to water
(iii) Evaporation of water
(iv) Dilution of an acid
(A) (i) and (ii) (B) (ii) and (iii)
(C) (iii) and (iv) (D) (ii) and (iv)

Q.3 $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$, is a
(i) combination r^{xn}
(ii) Displacement R^{xn}
(iii) redox R^{xn}
(iv) Double displacement R^{xn}
(A) (i) and (ii) (B) (ii) and (iii)
(C) (iii) and (iv) (D) (ii) and (iv)

Q.4 Silver Bromide, On expourse to sunlight turns grey due to
(A) Formation of silver by its decomposition
(B) Oxidation of silver Bromide
(C) Sublimation of silver Bromide
(D) Decomposition of bromine gas from silver bromide

Q.5 Water on electrolysis decomposes to hydrogen and oxygen. the mole ratio of H_2 and O_2 is
(A) 1 : 2 (B) 1 : 1
(C) 2 : 1 (D) 4 : 1

Q.6 Which of the following gases used for storage of fresh sample of an oil for a long time
(A) Nitrogen and Oxygen
(B) CO_2 and Helium
(C) CO_2 and oxygen
(D) Nitrogen and Helium

Q.7 50 ml of water was taken in a beaker A, B and C. A small amount of $CuSO_4$, NaOH and NaCl were added to beaker A, B and C respectively. The temperature of beaker A and B increased where in beaker c decreases. The correct statement (s) is/are
(i) In beaker "C" exothermic process has occurred.
(ii) In beaker "A" and "B" exothermic process has occurred.
(iii) In beaker A and B endothermic process has occurred.
(iv) In beaker "C" endothermic process has occured.
(A) (i) and (ii) (B) (ii) and (iii)
(C) (iii) and (iv) (D) (ii) and (iv)

Q.8 Example of a chemical change is
(A) fermentation of rice
(B) breathing
(C) curdling of milk
(d) all of above

Q.9 Which of the following is a double displacement reaction?
(A) $2H_2 + O_2 \longrightarrow 2H_2O$
(B) $FeSO_4 + Zn \longrightarrow ZnSO_4 + Fe$
(C) $CH_4 + 2O_2 \longrightarrow 2H_2O + CO_2$
(D) $Na_2SO_4 + Bacl_2 \longrightarrow BaSO_4 + 2Nacl$

Q.10 Which of the following is not a decomposition reacion?
(A) $CaCO_3 \longrightarrow CaO + CO_2$
(B) $2KClO_3 \longrightarrow 2KCl + 3O_2$
(C) Digestion of food in the body
(D) $H_2 + Cl_2 \longrightarrow 2HCl$

Q.11 Which of the following represent a double displacement reaction?
(A) $2H_2 + O_2 \longrightarrow 2H_2O$
(B) $2Mg + O_2 \longrightarrow 2MgO$
(C) $AgNO_3 + NaCl \longrightarrow AgCl \downarrow + NaNO_3$
(D) $H_2 + Cl_2 \longrightarrow 2HCl$

Q.12 Which of the following is a displacement reaction?
(A) $CaCO_3 \longrightarrow CaO + CO_2$
(B) $CaO + 2HCl \longrightarrow CaCl_2 + H_2O$
(C) $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$
(D) $NaOH + HCl \longrightarrow NaCl + H_2O$

Q.13 The reaction $H_2 + Cl_2 \longrightarrow 2HCl$ is a –
(A) Decomposition reaction
(B) Combination reaction
(C) Double displacement reaction
(D) Displacement reaction

Q.14 Which of the following is a decomposition reaction?
(A) $NaOH + HCl \longrightarrow NaCl + H_2O$
(B) $NH_4CNO \longrightarrow H_2NCONH_2$
(C) $2KClO_3 \longrightarrow 2KCl + 3O_2$
(D) $H_2 + I_2 \longrightarrow 2HI$

Q.15 Which of the following statement is incorrect?
(A) In oxidation, oxygen in added to a substance.
(B) In reduction, Hydrogen is added to a substance.
(C) Oxidizing agent in oxidized.
(D) Reducing agent is oxidized.

Q.16 Which of the following is a combustion reaction–
(A) Boiling of water
(B) Melting of wax
(C) Burning of petrol
(D) None of these

Q.17 Which of the following is a redox reaction?
(A) $CaCO_3 \longrightarrow CaO + CO_2$
(B) $H_2 + Cl_2 \longrightarrow 2HCl$
(C) $CaO + 2HCl \longrightarrow CaCl_2 + H_2O$
(D) $NaOH + HCl \longrightarrow NaCl + H_2O$

Q.18 Which statement is correct about the following reaction?

$$ZnO + CO \longrightarrow Zn + CO_2$$

(A) ZnO is being oxidized
(B) CO is being reduced
(C) CO_2 is being oxidized
(D) ZnO is being reduced

Q.19 The reaction $C + O_2 \longrightarrow CO_2 +$ Heat is a –
(A) Combination reaction
(B) Oxidation reaction
(C) Exothermic reaction
(D) All of the above

Q.20 Conversion of $CaCO_3$ in to CaO as per following reaction is an example of –

$$CaCO_3 \longrightarrow CaO + CO_2$$

(A) Decomposition reaction
(B) Reduction reaction
(C) Oxidation reaction
(D) None of these

Q.21 $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$ This reaction is an example of –
(A) Combination reaction
(B) Double displacement reaction
(C) Decomposition reaction
(D) Displacement reaction

Q.22 In reaction $SO_2 + 2H_2S \longrightarrow 2H_2O + 3S$ the reducing agent is –
(A) SO_2 (B) H_2S
(C) H_2O (D) S

Q.23 What happens when dil hydrochloric acid is added to iron fillings?
(A) Hydrogen gas and Iron chloride are produced.
(B) Chlorine gas and Iron hydroxide are produced.
(C) NO reaction takes place
(D) Iron salt and water are produced.

Q.24 When Iron nails are added to an aquous solution of copper sulphate, a chemical change occurs, which of the following is not true about this reaction?
(A) Blue colour of the solution fades.
(B) Iron nails becomes brownish in colour.
(C) It is a displacement reaction.
(D) Iron nails dissolves completly.

Q.25 Potassium reacts with bromine to form potassium bromide. **[NTSE]**
(A) $2K + Br \longrightarrow 2KBr$
(B) $K_2 + Br_2 \longrightarrow 2\ KBr$
(C) $K_2 + Br_2 \longrightarrow KBr_2$
(D) $K_2 + Br_2 \longrightarrow KBr$

Q.26 A silver spoon on exposure to air reacts with the sulphur present in air to give a black material called _____. **[NTSE]**

(A) Silver oxide (B) Silversulphide
(C) Tarnish (D) Coal tar

Q.27 In the decomposition of sulphates by heat, which is the gas formed exclusively along with the metal oxide? **[NTSE]**

(A) SO_2 (B) SO_3
(C) SO_3 and SO_2 (D) H_2SO_3

Q.28 Which among the following is not a physical change? **[NTSE]**

(A) Melting of solids to liquids
(B) Vapourisation of liquids to gases
(C) Liquefaction of gases to liquids
(D) Decay of matter

Q.29 Which among the following reactions are exothermic in nature? **[NTSE]**

(A) Bond formation
(B) Bond breaking
(C) Combustion of carbon
(D) Both (A) and (C)

Q.30 The reaction $P_4 + 3O_2 \longrightarrow 2P_2O_3$ is _____.

(A) synthesis reaction **[NTSE]**
(B) displacement reaction
(C) decomposition reaction
(D) combustion

Q.31 $PbO_2 + 4HCl \longrightarrow PbCl_2 + 2H_2O + Cl_2$. The substance undergoing oxidation is _____. **[NTSE]**

(A) lead dioxide (B) hydrochloric acid
(C) hydrogen (D) lead chloride

Q.32 In the equation $FeCl_3 + xNaOH \longrightarrow yNaCl + Fe(OH)_3$, the value of x and y, respectively, are _____. **[NTSE]**

(A) 3 and 1 (B) 3 and 3
(C) 2 and 3 (D) 3 and 4

Q.33 The rate of a chemical reaction is altered by _____. **[NTSE]**

(A) nature of reactants
(B) changing temperature
(C) using a catalyst
(D) all the above

Q.34 Which of the following is an example of a reversible reaction? **[NTSE]**

(A) $3Fe + 4H_2O \underset{}{\overset{1237\ K}{\rightleftharpoons}} Fe_3O_4 + 4H_2$

(B) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2\uparrow$
(C) $AgNO_3 + KCl \longrightarrow AgCl\downarrow + KNO_3$
(D) $NaOH + HCl \longrightarrow NaCl + H_2O$

Q.35 Which of the following reaction will not take place? **[NTSE]**

(A) $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$
(B) $2KI + Cl_2 \longrightarrow 2KCl + I_2$
(C) $Zn + MgSO_4 \longrightarrow ZnSO_4 + Mg$
(D) $Mg + CuSO_4 \longrightarrow MgSO_4 + Cu$

Q.36 When hydrogen sulphide gas is passed through a blue solution of copper sulphate, a black precipitate of copper sulphide is obtained and the sulphuric acid so formed remains in the solution. The reaction is an example of

(A) a combination reaction **[NTSE]**
(B) a displacement reaction
(C) a decomposition reaction
(D) a double decomposition reaction

Q.37 In the following equations $Na_2CO_3 + xHCl \longrightarrow 2NaCl + CO_2 + H_2O$ the value of x is: **[NTSE]**

(A) 1 (B) 2
(C) 3 (D) 4

Q.38 Combustion of fuel is **[NTSE]**

(A) displacement reaction
(B) double displacement reaction
(C) oxidation reaction
(D) isomerisation reaction

Q.39 The reaction between acid and base to form salt and water is an example of **[NTSE]**

(A) decomposition reaction
(B) combination reaction
(C) displacement reaction
(D) double displacement

Q.40 Which of the following reactions are exothermic in nature? **[NTSE]**

(A) Combustion of Carbon

(B) Bond breaking

(C) Bond formation

(D) Both (A) and (C)

Q.41 Which of the following changes is not a physical change? **[NTSE]**

(A) glowing of filament in bulb

(B) combustion

(C) boiling of water

(D) sublimation

Q.42 The substance that looses electrons is called as: **[NTSE]**

(A) oxidizing agent (B) reducing agent

(C) catalyst (D) none of above

Q.43 The process of reduction involves **[NTSE]**

(A) removal of hydrogen

(B) gain of electrons

(C) addition of oxygen

(D) loss of electrons

Q.44 In the reaction $H_2S + Cl_2 \longrightarrow 2HCl + S$, the oxidizing agent is: **[NTSE]**

(A) H_2S (B) Cl_2

(C) HCl (D) S

Q.45 Select Redox reaction from the following

(A) $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$ **[NTSE]**

(B) $CaO + 2HCl \longrightarrow CaCl_2 + H_2O$

(C) $NaOH + 2HCl \longrightarrow NaCl_2 + H_2O$

(D) $CaCO_3 \longrightarrow CaO + CO_2$

Q.46 Which of the following reactins is not correct? **[NTSE]**

(A) $2AgNO_3 + Cu \longrightarrow Cu(NO_3)_2 + 2Ag$

(B) $Cl_2 + 2KI \longrightarrow 2KCl + I_2$

(C) $FeSO_4 + Cu \longrightarrow CuSO_4 + Fe$

(D) $CuSO_4 + Zn \longrightarrow ZnSO_4 + Cu$

Q.47 Consider the reactions **[NTSE]**

$CuSO_4 + Fe \longrightarrow FeSO_4 + Cu$

$FeSO_4 + Zn \longrightarrow ZnSO_4 + Fe$

(A) Zn is most reactive, Fe is least reactive

(B) Fe is most reactive and cu is least reactive

(C) Zn is most reactive and cu is least reactive

(D) Cu is most reactions, Fe is least reactive

Q.48 Choose the incorrect statement. **[NTSE]**

(A) physical change is reversible

(B) physical change results information of new substances

(C) chemical change is permanent

(D) physical change is accompanied by energy change

Q.49 Which of following is fast reaction? **[NTSE]**

(A) reaction between H_2 and O_2 to form H_2O

(B) reaction between acid and base to form salt and water

(C) hydrolysis of ester

(D) hydrolysis of sugar to glucose

Answers

EXERCISE-II

Section-A

1. 1. +7/3 2. O 3. 2 4. +1 5. 0, +1, -2

2. 1. $MnO_4^- + 4H^+ + 2I^+ \rightarrow I_2 + MnO_2 + 2H_2O$

2. $2MnO_4^- + 5SO_2 + H^+ + 2H_2O \rightarrow 5HSO_4^- + 2Mn^{+2}$

3. $2Fe^{+2} + 2H^+ + H_2O_2 \rightarrow 2Fe^{+3} + 2H_2O$

4. $Cr_2O_7^{-2} + 3SO_2 + 2H^+ \rightarrow 2Cr^{+3} + 3SO_4^{-2} + H_2O$

5. $H_2S + 8HNO_3 \longrightarrow H_2SO_4 + 8NO_2 + 4H_2O$

6. $Bi + 3NO_3^- + 6H^+ \longrightarrow Bi^{3+} + 3NO_2 + 3H_2O$

7. $8Al + 3NO_3^- + 18H_2O + 5OH^- \longrightarrow 8Al(OH)_4^- + 3NH_3$

3. (i) 0 (ii) +2 (iii) –1 (iv) +3 (v) –1/2 (vi) +6

Section-B

1. (A) 2. (C) 3. (A) 4. (A) 5. (A)
6. (A) 7. (B) 8. (A) 9. (A) 10. (C)
11. (A) 12. (B) 13. (C) 14. (C) 15. (D)

Section-C

1. (D) 2. (C)

Section-D

1. (A)-(Q), (B)-(P), (C)-(S), (D)-(R)

EXERCISE-III

Section-A

1. (C) 2. (D) 3. (D) 4. (C) 5. (C)
6. (B) 7. (C) 8. (D) 9. (C) 10. (B)

Section-B

1. (A,C) 2. (A,B,D) 3. (B,C) 4. (A,D) 5. (A,B,C)
6. (A,D) 7. (B,D) 8. (A,C) 9. (A,B) 10. (A,B,D)

Section-C

Passage-1

1. (A) 2. (C) 3. (D)

Passage-2

1. (A) 2. (A) 3. (A)

Section-D

1. (A)-(Q,S), (B)-(R), (C)-(Q), (D)-(P)

EXERCISE-IV

1.	C	**2.**	D	**3.**	B	**4.**	A	**5.**	C	**6.**	D	**7.**	D
8.	D	**9.**	D	**10.**	D	**11.**	C	**12.**	C	**13.**	C	**14.**	C
15.	C	**16.**	C	**17.**	B	**18.**	D	**19.**	D	**20.**	A	**21.**	D
22.	B	**23.**	A	**24.**	D	**25.**	A	**26.**	B	**27.**	B	**28.**	D
29.	D	**30.**	D	**31.**	B	**32.**	B	**33.**	D	**34.**	A	**35.**	C
36.	D	**37.**	B	**38.**	C	**39.**	D	**40.**	D	**41.**	B	**42.**	B
43.	B	**44.**	B	**45.**	A	**46.**	C	**47.**	C	**48.**	B	**49.**	B

*****

ACIDS, BASES AND SALTS

INTRODUCTION

A wide variety of materials consists essentially of elements and compounds having different characteristics exist around us. Some of them are sour, some are bitter, while some are salty in taste.

For Example – Sour and bitter tastes of food are due to acids and bases, respectively, present in them. Acids react with bases to produce salt whose properties are different from acid and base.

ACIDS

The term "acid" is derived from the latin word "**acidus**" meaning sour to taste.

Example – Sour taste of lemon, unripened grapes, Vinegar, tomatoes etc.

◈ **According to Arrhenius theory :**

"An acid is a substance which dissolved in water, it ionizes and releases hydrogen ions [H^+(aq.)] in solution".

$$HCl(aq.) \longrightarrow H^+(aq.) + Cl^-(aq.)$$

Hydrochloric acid Hydrogen ion Chloride ion

or $HCl(g) + H_2O(\ell) \longrightarrow H_3O^{\oplus}(aq.) + Cl^-(aq.)$

Note :- Hydrogen ion do not exist as H^+ ions in solution, they attach themselves to the polar water molecules to form hydronium ions or hydroxonium ions, ($H_3O^{\oplus}$ or H^+(aq.))

$$H^+ + H_2O \longrightarrow H_3O^+$$

Hydrogen ion Water Hydronium ion

$$H_2SO_4(aq.) \longrightarrow 2H^+(aq.) + SO_4^{2-}(aq.)$$

Sulphuric acid Hydrogen ion Sulphate ion

$$HNO_3(aq.) \longrightarrow H^+(aq.) + NO_3^-(aq.)$$

Nitric acid Hydrogen ion Nitrate ion

CLASSIFICATION OF ACIDS

(I) On the basis of their source acids are of two type –

(i) Mineral acids (ii) Organic acids

(i) Mineral Acids (Inorganic acids) :-

The acids which are usually obtained from minerals are known as inorganic acids.

Name	Chemical Formula	Where found or used
Hydrochloric acid	HCl	In purification of common salt, in textile industry as bleaching agent, to make **aqua regia**.
Sulphuric acid	H_2SO_4	Commonly used in car batteries, in the manufacture of fertilizers (Ammonium phosphate, Super phosphate detergents etc, in paints, plastics, drugs) manufacture of artificial silk, in petroleum refining.
Nitric acid	HNO_3	Used in the manufacture of explosives (TNT, Nitroglycerine) and fertilizers (Ammonium nitrate, Calcium nitrate, Purification of Au, Ag.
Carbonic acid	H_2CO_3	In soft drinks. In stomach as gastric juice, used in tanning industry
Phosphoric acid	H_3PO_4	Used in antirust paints and in fertilizers

Do You Know?

Note : Aqua regia is a mixture of (3 part HCl & 1 part HNO_3) which dissolves even noble metals like Au, Pt.

(ii) Organic Acids :-

The acids which are usually obtained from plants and animals are known as organic acids.

Name	Where found or used
Formic acid (HCOOH)	Found in the stings of ants and bees, used in tanning leather, in medicines for treating gout.
Acetic acid (CH_3COOH)	Found in vinegar, used as solvent in the manufacture of dyes and perfumes.
Lactic acid	Responsible for souring of milk in curd
Benzoic acid	Used as a food preservative
Citric acid	Present in lemon, orange and citrus fruits
Tartaric acid	Present in tamarind.

(II) On the Basis of their Basicity :-

"The basicity of an acid is the number of replaceable hydrogen atoms present in a molecule that can be produced by the complete ionisation of one molecule of that acid in aqueous solution."

or

"Basicity of an acid is determined by number of hydronium ions ($H_3O^+/H^+(aq)$) produced per molecule of an acid on ionisation."

(i) Monobasic Acids :-

The acid on complete ionisation produce one hydronium ion in aqueous solution.

Example : Hydrochloric acid (HCl)
Hydrobromic acid (HBr)
Hydrofluoric acid (HF)
Hydroiodic acid (HI)
Nitric acid (HNO_3)
Acetic acid (CH_3COOH)
Formic acid (HCOOH)

$HCl + H_2O \longrightarrow H_3O^{\oplus}$ (Hydronium ion) $+ Cl^-$ (Chloride ion)

$CH_3COOH + H_2O \longrightarrow H_3O^{\oplus}$ (Hydronium ion) $+ CH_3COO^-$ (Acetate ion)

$HNO_3 + H_2O \longrightarrow H_3O^{\oplus}$ (Hydronium ion) $+ NO_3^-$ (Nitrate ion)

(ii) Dibasic Acid :-

The acid on complete ionisation produces two hydronium ions in aqueous solution.

Example : Sulphuric acid (H_2SO_4)
Carbonic acid (H_2CO_3)
Oxalic acid $(COOH)_2$

$H_2SO_4 + H_2O \longrightarrow H_3O^{\oplus} + HSO_4^-$ (Bisulphate ion) (Step – I)

$HSO_4^- + H_2O \longrightarrow H_3O^{\oplus} + SO_4^{2-}$ (Sulphate ion) (Step – II)

(iii) Tribasic Acid :-

The acid on complete ionisation produces three hydronium ions in aqueous solution.

Example :

$$H_3PO_4 + 3H_2O \longrightarrow \underset{\text{Hydronium ion}}{3H_3O^{\oplus}} + \underset{\text{Phosphate ion}}{PO_4^{-3}}$$

(III) Classification on the basis of their strength :-

(i) Strong Acid :-

The acid which undergoes complete ionisation in aqueous solution are known as strong acids.

Example :

$HCl + Water \longrightarrow H^+(aq) + Cl^-(aq)$

$H_2SO_4 + Water \longrightarrow 2H^+(aq) + SO_4^{2-}(aq)$

$HNO_3 + Water \longrightarrow H^+(aq) + NO_3^-(aq)$

} Complete ionised

(ii) Weak Acid :-

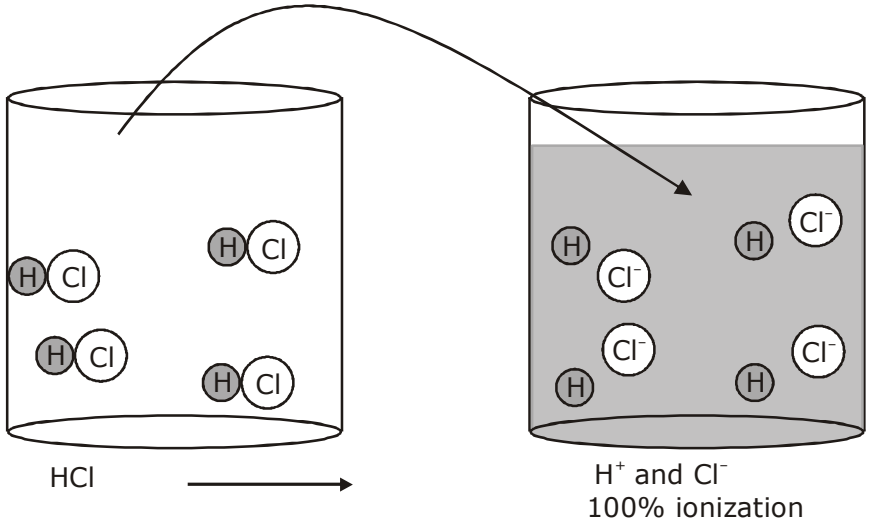
The acid which undergoes partial or incomplete ionisation in aqueous solution are known as weak acids.

$CH_3COOH + Water \longrightarrow CH_3COO^-(aq) + H^+(aq)$

Acetic acid — Acetate ion

Example : Formic acid ($HCOOH$), Oxalic acid $(COOH)_2$

Carbonic acid (H_2CO_3), phosphoric acid (H_3PO_4)



Strong acids completely dissociate in water

(IV) Classification on the basis of concentration of the Acid :-

(i) Concentrated Acid :-

The acids which contains very small amount of water is called a concentrated acid.

(ii) Dilute Acid :-

The acids which contains more amount of water is called a dilute acid.

"Strength of an acid is not depend upon the concentration of an acid"

Strength of an Acid ∝ Concentration of hydronium ion.

Do You Know?
Acids are responsible to digest food in the stomach, dissolve rock, to make fertilizer, dissolve your tooth enamel to form cavities.

Do You Know?
Strength of an acid does not depend upon the concentration of an acid,but on the concentration of hydronium ion

BASES

Substances with bitter taste and give a soapy touch are known as bases but many bases have corrosive nature. So bases are defined as "

- **According to Arrhenius :**

those substances which give hydroxide or hydroxyl ion (OH^-) in their aqueous solution" are **called bases.**

$NaOH(aq.) \rightarrow Na^+(aq) + OH^-(aq)$

$KOH(aq.) \rightarrow K^+(aq) + OH^-(aq)$

Example – Sodium hydroxide (NaOH), Zinc oxide (ZnO), Copper oxide (CuO), Calcium hydroxide [$Ca(OH)_2$], Aluminium hydroxide [$Al(OH)_3$].

- The compounds which are either metallic oxides or metallic hydroxides. Which combines with acids to form salts and water only.

CuO	+	$2HCl$	$\longrightarrow$	$CuCl_2$	+	H_2O
Base		Acid		Salt		Water
$NaOH$	+	HCl	$\longrightarrow$	$NaCl$	+	H_2O
Base		Acid		Salt		Water
$Mg(OH)_2$	+	H_2SO_4	$\longrightarrow$	$MgSO_4$	+	$2H_2O$
Base		Acid		Salt		Water

◈ **Alkalis**

Bases which completely dissolves in water are called alkalis.

Examples – KOH, NaOH, $Ca(OH)_2$

All the alkalis are bases but all bases are not alkalis.

Examples – [$Fe(OH)_3$] ferric hydroxide and cupric hydroxide [$Cu(OH)_2$] are base, but not an alkali.

◈ **CLASSIFICATION OF BASES**

(I) Classification on the basis of their strength :-

(i) Strong alkalis or bases :-

The alkalis or bases which undergo almost complete ionisation in aqueous solution are known as strong alkalis or bases.

Examples –

$NaOH(aq.) \longrightarrow Na^+(aq) + OH^-(aq)$
Sodium hydroxide

$KOH(aq.) \longrightarrow K^+(aq) + OH^-(aq)$
Potassium hydroxide

$Ba(OH)_2(aq.) \longrightarrow Ba^+(aq) + 2OH^-(aq)$
Barrium hydroxide

} Complete ionisation

(ii) Weak alkalis or bases :-

The alkalis or bases which undergo only partial ionisation in aqueous solution are known as weak alkalis or Bases.

Example –

$Ca(OH)_2(aq.) \longrightarrow Ca^{2+}(aq) + 2OH^-(aq.)$
Calcium hydroxide

$Mg(OH)_2(aq.) \longrightarrow Mg^{2+}(aq) + 2OH^-(aq.)$
Magnesium hydroxide

} Partial Ionisation

(II) Classification on the basis of their concentration –

(i) Concentrated Base or Alkali –

The bases or alkalis which contain very small amount of water is called a concentrated bases or alkalis.

(ii) Dilute Base –

The bases or alkali which contain more amount of water is called a dilute bases or alkalis.

(III) Classification on the basis of their acidity –

Acidity of a base is determined by the number of hydroxyl (OH^-) ions produced by per molecule of a Base or Alkali on complete dissociation in water "or"

The "number of hydrogen ions of an acid with which a molecule of that alkali or base react to produce salt and water is known as acidity of an alkali or Base".

(i) Mono acidic Bases or Alkali –

The base or alkali on complete ionisation produce one hydroxyl (OH^-) ion in aqueous solution.

Example – $NaOH(aq.) \longrightarrow Na^+(aq) + OH^-(aq)$

Hydroxyl ion

$KOH(aq.) \longrightarrow K^+(aq) + OH^-(aq)$

Hydroxyl ion

(ii) Diacidic Bases (or alkalis) –

The base or alkali on complete ionisation produce two hydroxyl ion (OH^-) in aqueous solution

Example –

(A) Diacidic Bases of –

$Ca(OH)_2(aq.) \longrightarrow Ca^{2+}(aq.) + 2OH^-(aq.)$

$Mg(OH)_2(aq.) \longrightarrow Mg^{2+}(aq.) + 2OH^-(aq.)$

(B) Diacidic Bases –

Ferrous hydroxide $[Fe(OH)_2]$ and copper hydroxide $[Cu(OH)_2]$

$Fe(OH)_2(aq.) \longrightarrow Fe^{2+} + 2OH^-(aq.)$

$Fe^{+2}(OH)_2^- + 2H^+Cl^-(aq.) \longrightarrow FeCl_2 + 2H_2O$

(iii) Tri Acidic Bases –

The base or alkali on complete ionisation produce three hydroxyl ion $(OH)^-$ in aqueous solution.

Example – Aluminium hydroxide $[Al(OH)_3]$, Ferric hydroxide $[Fe(OH)_3]$

$Al(OH)_3(aq.) \longrightarrow Al^{3+}(aq.) + 3OH^-(aq.)$

$Al^{3+}(OH)_3^- + 3HCl(aq.) \longrightarrow AlCl_3 + 3H_2O$

Q. Identify strong and weak acids as well as strong and weak bases from the following. H_2CO_3. CH_3COOH, NaOH, NH_4OH, KOH, $Ca(OH)_2$, HCl.

Do You Know?

Bases like NaOH and KOH have corrosive nature i.e. they are caustic, so known as caustic soda and caustic potash respectively.

PROPERTIES OF ACID

(I) Physical properties of Acid –

The important properties of acids are given below

(i) Acids have a sour taste.

(ii) Acids turn blue litmus to red.

(iii) Acid solution conduct electricity (They are electrolytes).

(iv) Effect on Skin – All strong mineral acids have a corrosive action on skin and cause painful burns.

Example – Concentrated sulphuric acid stains the skin black.

Concentrated nitric acid & hydrochloric acid stains the skin yellow.

(v) Electrical Conductivity – All mineral acids are good conductors of electricity and conduct electricity in their aqueous solution. On electrolysis, they decompose liberating hydrogen at cathode.

(II) Chemical Properties of Acids

(i) Acids react with metal to form hydrogen gas

Most of the acids react with mtals to form salts and evolve hydrogen gas.

$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$

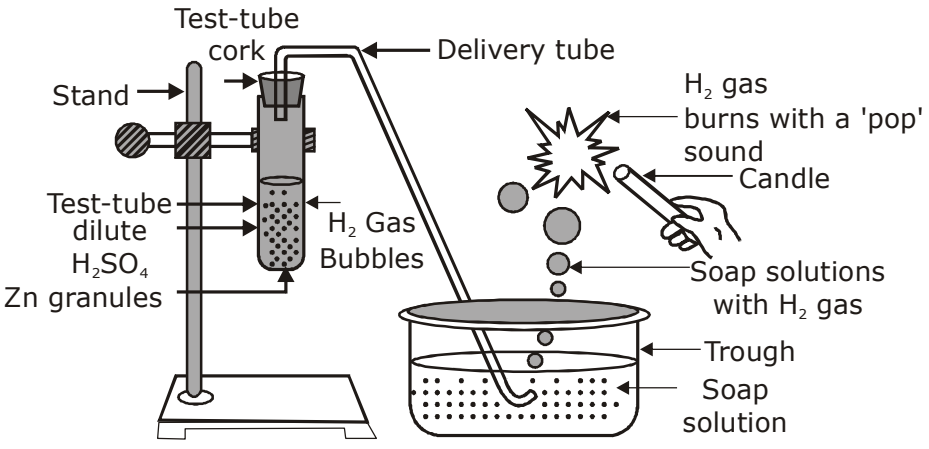
Most of the acid react with metal to form solid and evolve hydrogen gas.

Do You Know?
Curd and other sour food-stuffs should not be kept in metal vessels (like copper vessels or brass vessels). This is because curd and other sour food - stuffs contain acids which can react with the metal of the vessel to form poisonous metal compounds which can cause food poisoning and damage our health.

ACTIVITY - 1

Object: To show the reaction of acids on metals.

Take a test-tube. Add to it about 5 mL of dilute H_2SO_4 and a few pieces of zinc granules. Set up the apparatus as shown in figure.



Reaction of Zn granules with dilute H_2SO_4 and testing the evolved H_2 gas by burning

(ii) Acids react with metal carbonates (and metal hydrogen carbonates) to form carbon dioxide gas.

(a) When dilute hydrochloric acid react with soldium carbonate then sodium chloride, carbondioxide and water is formed.

$Na_2CO_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$

Sodium carbonate | Hydrochloric acid | sodium chloride | carbon dioxide | water

(b) When dilute hydrochloric acid react with sodium hydrogencarbonate, then sodium chloride, carbon dioxide and water are formed.

$NaHCO_3(s) + HCl(aq) \longrightarrow NaCl(aq) + CO_2(g) + H_2O(\ell)$

Sodium hydrogen carbonate | Hydrochloric acid | sodium chloride | carbon dioxide | water

Do You Know?

Test for carbonate and hydrogen carbonate:

Reaction of carbonates and hydrogen carbonates with acids is used to detect their presence. If a compound evolves a gas reacting with acid and gas turns lime water milky. The evolved gas is carbon dioxide and compound is carbonate or hydrogen carbonate.

Lime water + carbon dioxide $\longrightarrow$ milky colour due to formation of $CaCO_3$(ppt).

If we pass excess of carbon dioxide through milky lime water, the precipitate of $CaCO_3$ dissolves and milkiness of lime water dissapears due to the formation of calcium hydrogen carbonate which is soluble in water.

$CaCO_3(s) + H_2O(l) + CO_2(g) \longrightarrow Ca(HCO_3)_2(aq)$

(Soluble in Water)

ACTIVITY - 2

Object: To show the reaction of acids with metal carbonates and metal hydrogen carbonates.

Method:

(i) Take two test tubes and mark them 1 and 2.

(ii) Take about 0.5g of sodium carbonate (Na_2CO_3) in test tube 1 and 0.5g of sodium hydrogen carbonate in test tube 2.

(iii) Add about 2 mL of dilute hydrochloric acid to test tube 1 and pass the evolved gas into lime water.

(iv) Now, add about 2 mL of dilute hydrochloric acid to test tube 2 and pass the evolved gas into lime water.

Observation: When dilute hydrochloric acid is added to either sodium carbonate or sodium hydrogen carbonate, a gas is evolved which turns lime water milky, Hence the gas produced is carbon dioxide. So the chemical equations for the reaction taking place, may be written as follows:

$Na_2CO_2(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$

$NaHCO_3(s) + 2HCl(aq) \longrightarrow NaCl(aq) + H_2O(l) + CO_2(g)$

(III) Acids react with bases (or alkalis) to form salt and water :

Acid + Base $\longrightarrow$ Salt + Water

The reaction between an acid and a base to form salt and water is called a neutralisation reaction.

$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$

Sodium hydroxide | Hydrochloric acid | Sodium chloride | Water

ACTIVITY - 3

Object: To show reaction of acids with bases.

Method:

(i) Take about 2-3 mL of dilute NaOH solution in a test-tube and add 2 drops of phenolphthalein solution (indicator) to it. the colour of solution will change to pink.

(ii) Now add dilute hydrochloric acid to it drop by drop till the pink colour of above solution disappears.

Observation: In the above activity, pink colour of solution disappears because the effect of base is nullified by the acid and vice-versa. The chemical equation for the reaction we can write as given below:

$$\underset{\text{Base}}{NaOH(aq)} + \underset{\text{Acid}}{HCl(aq)} \longrightarrow \underset{\text{Salt}}{NaCl(aq)} + \underset{\text{Water}}{H_2O}$$

Result: The above mentioned activity shows that an acid neutralizes a base in aqueous solutio. It is termed as neutrilisation reaction. We can generalise the above reactions:

$$\boxed{\text{Base} + \text{Acid} \rightarrow \text{Salt} + \text{Water}}$$

(IV) Acids react with metal oxides to form salt and water :

Acids react with metal oxides to form salt and water :

Metal oxide + Acid ⟶ Salt + Water

Copper(II) oxide is a metal oxide. Dilute hydrochloric acid reacts with copper(II) oxide to form copper(II) chloride and water :

$$\underset{\substack{\text{Copper (II) oxide}}}{CuO(s)} + \underset{\substack{\text{Hydrochloric acid}}}{2HCl(aq)} \longrightarrow \underset{\substack{\text{Copper (II) chloride (Blue Green)}}}{CuCl_2(aq)} + \underset{\substack{\text{Water}}}{H_2O(l)}$$

Do You Know?
The antacid called **'Milk of Magnesia (MgO)'** which is used to remove indigestion (caused by too much hydrochloric acid in the stomach) is a metal hydroxide called 'Magnesium hydroxide.'

ACTIVITY - 4

Object: To show the reaction of acids on metal oxides.

Method:

(i) Take about 2g black copper (II) oxide in a beaker.

(ii) Add dilute hydrochloric acid to it slowly with stirring.

Observation: Slowly copper (II) oxide dissolves and solution of blue-green colour is formed which is copper (II) chloride. The chemical equation for the reaction is as follows:

$$\underset{\text{Black}}{CuO(s)} + 2HCl(aq) \longrightarrow \underset{\text{Blue-Green}}{CuCl_2(aq)} + H_2O(l)$$

Result: The abouve mentioned activity shows that generally metal oxides react with acids to form salt and water.

$$\boxed{\text{Metals} + \text{Acid} \rightarrow \text{Salt} + \text{Water}}$$

(V) Acids have corrosive nature :

This mineral acids causes severs burns on the skins and attack and eat up materials like clothes,wood,metal structures and stonework, so they are said to be corrosive. Acids are never stored in metal containers because they gradually corrode and eat up the metal container.

The strong bases (or alkalies) such as sodium hydroxide are also very corrosive, and attack and destroy our skin.

◈ WHAT IS COMMON IN ALL ACIDS?

An acid is a substance which dissociates (on ionises) on dissolving in water to produce hydrogen ion [H^+ (aq) ions].

$HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$

Hydrochloric acid Hydrogen ions Chloride ions

A common thing in all the acids is that they produce hydrogen ions [H^+ (aq) ions] when dissolved in water.

$H_2SO_4(aq) \longrightarrow 2H^+(aq) + SO_4^{2-}(aq)$

$CH_3COOH(aq) \longrightarrow CH_3COO^-(aq) + H^+(aq)$

Do You Know?

The aqueous solutions of glucose and alcohol do not show acidic character because their hydrogen does not separate out as hydrogen ions [H^+(aq) ions] on dissolving in water.

ACTIVITY - 5

Object: To show the conduction of current by acids.

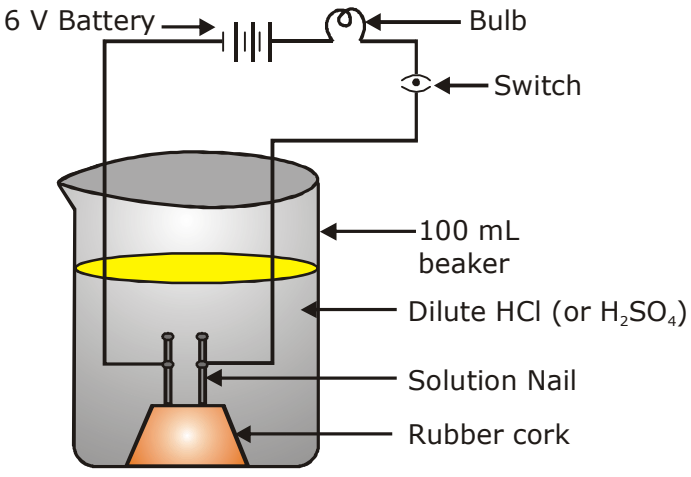
Method:

(a) Fix two nails on a cork and place it in a 100 mL capacity beaker. Connect the nails to the terminals of 6V battery, through a bulb and a switch, as shown in figure.

(b) Now take enough dilute HCl in the beaker so that the two nails are immersed in the acid. Switch on the current. We notice that the bulb starts glowing.

(c) Now repeat the experiment separately with dilute H_2SO_4. Similar results (as above) are obtained. Thus we can conclude that dilute acids (HCl, H_2SO_4, etc.) conduct electricity.

(d) Now repeat the experiment separately with glucose solution ($C_6H_{12}O_6$) and alcohol (C_2H_5OH) solution. You will observe that the bulb does not glow in any of the two cases. In other words, glucose and alcohol do not conduct electricity.



Demonstration of conduction electricity through an acid solution

Explanations: Glowing of bulb in case of acids indicates that there is a flow of electricity current through the solution. the current as carried through the solution by ions (H^+ and Cl^- in case of HCl and H^+ and SO_4^{2-} in case of H_2SO_4). Now all acids contain the cation (positive ion) H^+, so this suggests that all acids yield hydrogen ions H^+ (aq), in solution, which are responsible for their acidic nature (or properties).

◈ **USES OF MINERAL ACIDS IN INDUSTRY :**

1. Sulphuric acid is used in the manufacture of fertilizers (like ammonium sulphate), paints, dyes, chemicals, plastics, synthesis fibres, detergents, explosives and car batteries.

2. Nitric acid is used for making fertilisers (like ammonium nitrate), explosivs (like TNT : Tri-Nitro Toluene), dyes and plastics.

3. Hydrochloric acid is used for removing oxide film from steel objects (before they are galvanised) and for removing 'scale' deposits from inside the boilers.

PROPERTIES OF BASES

◈ **PHYSICAL PROPERTIES OF BASES**

The important properties of water soluble bases (or alkali) are given below :

1. Bases have bitter taste.

2. Bases feel soapy to touch.

3. Bases turn red litmus to blue.

4. Bases conduct electricity in solution (They are electrolytes).

Do You Know?
The saliva produced in the mouth by salivary glands is of alkaline nature. It also partially neutralises the acid present in the mouth.

◈ **CHEMICAL PROPERTIES OF BASES**

1. Bases react with some metals to form hydrogen gas.

$$2NaOH(aq) + Zn(s) \xrightarrow{Heat} Na_2ZnO_2(aq) + H_2(g)$$

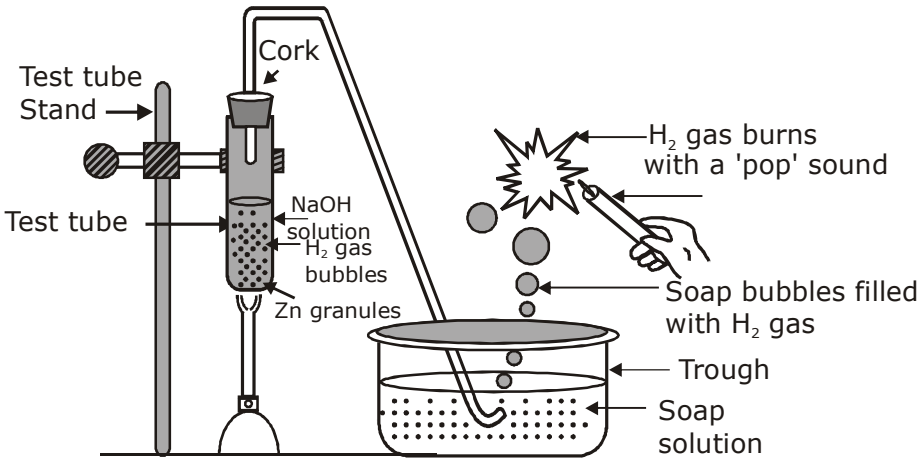
sodium hydroxide (Base) — Zinc — sodium zincate (Salt) — hydrogen

All the metals do not react with bases to form salts and hydrogen.

ACTIVITY - 6

Object: To show the reaction of bases on metals.

Method: Take a test-tube. Add to it about 2 mL of sodium hydroxide solution and a few pieces of granulated zinc metal. Set up apparatus as shown in figure. Warm the contents of the test-tube and make observations.



Reaction of Zn metal with NaOH

Observations:

(a) A gas (hydrogen) is evolved, which on passing through soap solution form soap bubbles filled with H_2 gas.

(b) When we burn carefully the soap bubbles filled with H_2 gas with a candle, a 'pop' sound is boserved.

(c) In the above reaction, hydrogen is displaced from the bases and is evolved as H_2 gas.

(d) The metals combine with the remainder part of the bases to form, a compound, called sat. Thus:

Base + Metals $\longrightarrow$ Salt + H_2 (g)

e.g $2NaOH(aq) + Zn(s) \longrightarrow \underset{\text{sodium Zincate}}{Na_2 ZnO_2} (aq) + H_2(g)$

Note: Such reactions are not possible with all metals and this reaction is different from reaction of metals with acids. In this reaction OH^- ion gives ZnO_2^{2-} (zincate ion) and hydrogen gas.

2. Bases react with acids to form salts and water

$2NaOH(aq) + H_2SO_4(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$

sodium hydroxide — sulphuric acid — sodium sulphate — Water

(Base) (acid) (salt)

when an acid and base combine then the real neutralisation reaction occurs due to the combination to hydrogen ions present in acid and hydroxide ions present in base to form water.

$H^+(aq) + OH^-(aq) \xrightarrow[\text{reaction}]{\text{Neutralisation}} H_2O(I)$

hydrogen ions — hydroxide ions — Water

(From acid) (From base)

3. Bases react with non-metal oxides to form salt and water :

Non - metal oxide + Base $\longrightarrow$ Salt + Water

$Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O(\ell)$

calcium hydroxide — carbon dioxide — calcium carbonat — water

(Base) (Non-metal oxide) (salt)

The reactions of non-metal oxides with bases to form salt and water show that non-metal oxides are acidic in nature.

ACTIVITY - 7

Object: To show the reaction of a base with non-metallic oxides.

Method: Take calcium hydroxide solution (a base) in a test-tube and pass carbon dioxide (a non-metallic oxide) through it. The product is calcium carbonate precipitate (in the form of milkiness) and water. Thus:

$\underset{\text{Calcium hydroxide (a base)}}{Ca(OH)_2} + \underset{\text{Carbon dioxide (an acidic oxide)}}{CO_2} \longrightarrow CaCO_3(s) + H_2O(l)$

Result: From the above activity we can conclude that non-metallic oxides are acidic in nature, since they produce acids with water, e.g.,

$CO_2(g) + H_2O(l) \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_3(aq)}$

$\underset{\text{Sulphur dioxide (An acidic oxide)}}{SO_2(g)} + H_2O(l) \longrightarrow \underset{\text{Sulphurous acid}}{H_2SO_3(aq)}$

◈ **USES OF BASES :**

(i) Sodium hydroxide is used in the manufacture of soap, paper and a synthesis fibre called **'rayon'.**

(ii) Calcium hydroxide (**slaked lime**) is used in the manufacture of bleaching powder.

(iii) Magnesium hydroxide is used as an antacid to neutralise excess acid in the stomach and cure indigestion.

DIFFERENCE BETWEEN ACIDS & BASES

Acids		Bases	
(i)	Sour in taste.	(i)	Bitter in taste.
(ii)	The properties are due to the presence of hydrogen ion (H^+) in water solution of an acid.	(ii)	The properties are due to the presence of hydroxide ion (OH^+) in water solution of a base.
(iii)	Turns blue litmus to red.	(iii)	Turns red litmus to blue.
(iv)	Aqueous solution conducts electricity.	(iV)	Aqueous solution conducts electricity.
(v)	Reacts with active metals like Na, K, Ca and Zn to give hydrogen gas.	(v)	Does not react with metals except with Zn, Al and Sn.
(vi)	Acidic properties disappear when react with bases (Neutralization).	(vi)	Basic properties disappear when react with acids (Neutralization).
(vii)	Reacts with carbonates to give carbon dioxide.	(vii)	Absorbs carbon dioxide to form carbonate.
(viii)	Frequently corrosive to skin.	(viii)	Frequently corrosive to skin and slippery in nature.
(ix)	The pH value is less than 7 at 25°C.	(ix)	The pH value is greater than 7 at 25°C.

What happens when water is mixed with an acid or a base?

Mixing of acid or base in water is called dilution and the acid or the base is said to be diluted.

During dilution, concentration of ions (H_3O^+ OH^-) per unit volume decreases. This process is generally exothermic in nature, which produces heat. Heat produced may be harmful because it may cause the mixture to splash out and cause burns. Moreover the glass container may also break due to excessive local heating. So precautions are recommended during dilution of an acid or bases.

STRENGTH OF ACID AND BASE SOLUTIONS : PH SCALE

Acidic solutions have excess of hydrogen ions. The basic solutions have excess of hydroxide ions. In **1909 Sorenson** developed a scale (known as pH scale) on which the strength of acid solutions as well as basic solutions could be represented by making use of the hydrogen ion concentration in them.

The pH of a solution is inversely proportional to the concentration of hydrogen ions in it.

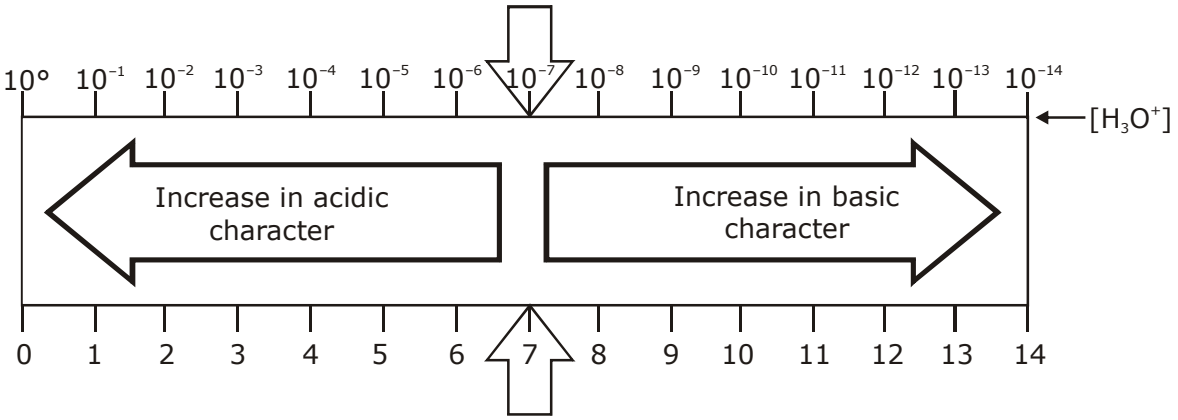
The strength of an acid or base in measured on a scale of number called the pH scale. The pH scale has values from 0 to 14.

1. Neutral substances have a pH of exactly 7. The pH of pure water is 7.

A substance having pH 7 will have no effect on litmus or any other common indicator such as methyl orange or phenolphthalein.

2. All the solutions having pH less than 7 are acidic in nature and hence they turn blue litmus to red. They also turn methyl orange indicator red.

3. Bases (or basic solutions) have a pH or more than 7. The more basic a solution is, the higher will be its pH. The higher thepH, the stronger the base (or alkali). All the substances having pH more than 7 are basic in nature (or alkaline in nature) and hence they turn red litmus to blue. They also turn phenolphthalin indicator pink.



pH scale

INDICATORS

Indicator as the name suggests, indicates the nature of particular solution whether acidic, basic or neutral. Apart from this, indicator also represents the change in nature of the solution from acidic to basic & vice-versa, Depending upon the property of the indicator, we have the following two types of acid-base indicators:

(1) Indicators showing different colours in acidic & basic medium.

Examples, Litmus, phenolphthalein and methyl orange.

(2) Indicators giving different odour in acidic and basic medium/olfactory indicators.

Examples, Onion extract, vanilla and clove oil.

ACTIVITY - 8

Aim: To test acids and bases in the laboratory using colour change acid-base indicators.

Method

(i) Collect the following samples from the science laboratory-hydrochloric acid (HCl), sulphuric acid (H_2SO_4), nitric acid (HNO_3), acetic acid (CH_3COOH), sodium hydroxide (NaOH), calcium hydroxide [$Ca(OH)_2$], potassium hydroxide (KOH) , magnesium hydroxide [$Mg(OH)_2$] and ammonium hydroxide (NH_4OH).

(ii) Put a drop of each of the above solutions on a watch-glass and test with a drop of the follOwing indicators.

Red litmus solution, Blue litmus solution, Phenolphthalein solution, Methyl orange solution.

Now answer: What change in colour do you observe with each of the above indicators?

Discussion: The changes observed are as follows:

Sample Solution	Red litmus solution	Blue litmus solution	Phenolphthalein solution	Methyl orange solution
Hydrochloric acid (HCl)	No effect	Red	Colourless	Red
Sulphuric acid (H_2SO_4)	No effect	Red	Colourless	Red
Nitric acid (HNO_3)	No effect	Red	Colourless	Red
Acetic acid (CH_3COOH)	No effect	Red	Colourless	Red
Sodium hydroxide (NaOH)	Blue	No. effect	Pink	Yellow
Calcium hydroxide $Ca(OH)_2$	Blue	No. effect	Pink	Yellow
Potassium hydroxide (KOH)	Blue	No. effect	Pink	Yellow
Magnessium hydroxide $mg(OH)_2$	Blue	No. effect	Pink	Yellow
Ammonium hydroxide (NH_4OH)	Blue	No. effect	Pink	Yellow

Conclusion:
(i) Acids turn blue litmus red but have no effect on red litmus.
(ii) Bases turns red litmus blue but have no effect on blue litmus.
(iii) Phenolphthalein is colourless in acidic medium and turns pink in basic medium.
(iv) Methyl orange is yellow in basic medium and red in acidic medium.

Do You Know?
The pH of human blood varies between 7.36 to 7.42. It is maintained by the soluble hydrogen carbonates and carbonic acid present in blood. These are known as 'buffer'. In general, the role of different buffer is to help in controlling the pH of solution.

◈ **UNIVERSAL INDICATORS :**

Universal indicator is a mixture of many different indicators (or dyes) which gives different colours at different pH values of the entire pH scale. When an acid or base solution is added to the universal indicator, the indicator produces a new colour. The colour produced by universal indicator is used to find the pH value of the acid or base solution by matching the colour with the colours on pH colour chart.

pH	Colours
0	Dark red
1	Red
2	Red
3	Orange Red
4	Orange
5	Orange yellow
6	Greenish yellow
7	Green
8	Greenish blue
9	Blue
10	Navy blue
11	Purple
12	Dark purple
13	Violet
14	Violet

Just like litmus, universal indicator can be used either in the form of a solution or in the form of universal indicator paper.

Water will produce a green colour with universal indicator.

◈ OLFACTORY INDICATORS :

Those substances whose smell (or odour) changes in acidic or basic solutions are called olfactory indicators. Onion and vanilla extract are olfactory indicators.

ACTIVITY - 9

Aim: To test acids and bases using olfactory indicators.

Method:

(i) Take some finely chopped onion in a plastic bag along with some strip of dean cloth. Tie up the bag tightly and leave overnight in the fridge.

The cloth strips can now be used to test for acids and bases.

(ii) Take two of these cloth strips and check their odour.

(iii) Keep them on a clean surface and put a few drops of dilute HCl solution on one strip and a few drops of dilute NaOH solution on the other.

(iv) Rinse both cloth strips with water and again check their odour.

(v) Note your observations.

(vi) Now take some dilute vanilla essence and clove oil and check their odour.

(vii) Take some dilute HCl solution in one test tube and dilute NaOH solution in another. Add a few drops of dilute vanilla essence to both test tubes and shake well. Check the odour once again and record change in odour, if any.

(viii) Similarty, test the change in the odour of clove oil with dilute HCl and dilute NaOH solutions and record your observation.

Discussion: On the basis of your observations, report which of the following vanilla, onion and clove oil can be best used as an olfactory indicator.

Conclusion: A substance which has an odour in acidic medium and different odour in basic medium can be used as an acid base indicator (caped olfactory indicator).

Do You Know?
The concentration of H^+ (aq) and OH^- (aq) ions in pure water is 1×10^{-7} mol litre^{-1} each and equal to each other that makes its pH = 7.

Do You Know?
If $[H^+] = 10^{-x}$ M, then pH = x e.g. If $[H^+] = 10^{-3}$ M then pH = 3 It shows acidic pH.

IMPORTANCE OF pH IN EVERYDAY LIFE

1. pH in our Digestive System :

Our stomach produces hydrochloric acid helps in digesting our food. The excess acid in the stomach causes indigestion which produces pain and irritation. Antacids are a group of mild bases which have no toxic effects on the body, react with excess acid in the stomach and neutralise it. The two common antacids used for curing indigestion due to acidity are : Magnesium hydroxide (Milk of Magnesia) and Sodium hydrogen carbonate (Baking soda).

2. pH change as the cause of Tooth decay :

The bacteria present in our mouth break down the sugar to form acids. This acid lowers the pH in the mouth (making decay) is to clean the mouth thoroughly after eating food.

Tooth enamel is made up of calcium phosphate, the hardest substance in our body and it does not dissolve in water. Tooth starts decaying, when pH of the mouth is less than 5.5, due to corrosion of calcium phosphate. Bacteria present in the mouth produce acid by the degradation of carbohydrates (like sugar) and food particles still remaining in the mouth after eating. The best method of preventing tooth decay is to clean the mouth after eating and avoid eating sugar foods (such as sweets, toffees etc.). Most common tooth pastes are basic in nature so by using these for cleaning the teeth, the excess acid gets neutralized thereby pH becomes greater than 5.5 and tooth decay is prevented.

3. Plants and Animals are Sensitive to pH Changes :

Soil pH and Plant Growth : Most of the plants grow best when the pH of the soil is close to 7. If the soil is too acidic (having low pH), then it is treated with materials like quicklime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate). If the soil is too alkaline then its alkalinity can be reduced by adding decaying organic matter (manure or compost) which contains acidic materials.

In plants and animals: Living organisms can survive only in a narrow range of pH values. eg.g, our body can work within 7.0 to 7.5 pH range. When pH of rain water is below 5.6 (due to absorption of acidic gases like CO_2, SO_2, NO_2 etc. present n the atmosphere), it is known as acid rain, which on flowing into the rivers lowers the pH of the river water, thereby survival of aquatic life in such rivers becomes difficult.

4. Self Defence by Animals and Plants Through Chemical Warfare :

Many animals and plants protect themselves from their enemies by injecting painful and irritating acids and bases into their skin. **For example** when a honey bee stings a person, it injects an acidic liquid into the skin which causes immense pain and irritation. An ant's sting injects methanoic acid (HCOOH) into the skin of a person causing burning pain.

When a person happens to touch the leaves of a nettle plant accidently, the stinging hair of nettle leaves inject methanoic acid into the skin of the person causing burning pain.

pH Value of Some Common Substances

S.No.	Solution	Colur of pH paper	Approximate pH value	Nature of substance
1	Saliva (before meal)	Blue	7.4	Basic
2	Saliva (after meal)	Yellow	5.8	Acidic
3	Lemon juice	Red	2.3	Acidic
4	Colourless aerated drink	Red-orange	3	Acidic
5	Carrot juice	Yellowish green	6	Acidic
6	Coffee	Yellow	5	Acidic
7	Tomato juice	Orange	4.1	Acidic
8	Tap water	Greenish blue	7.4	Basic
9	1M NaOH	Dark violet	14	Acidic
10	1M HCl	Dark red	0	Acidic

pH Value of Some Common Substances

Solution	pH Value	Solution	pH Value
1 M-Hydrochloric acid	0	10 M HCl	1.0
1 M-Sodium hydroxide	14.0	0.1 M Sodium hydroxide	13.0
Gastric Juice	1–3	Lemon juice	2.2–2.4
Vinegar	2.4–3.4	Tomato juice	4.0–4.4
Saliva (before meals)	6.5–7.5	Saliva (after meals)	5.8
Coffee	4.5–5.5	Soft drinks	3.0
Blood	7.4	Eggs	7.8
Toothpaste	8.0	Baking Soda Solution	8.5
Washing Soda Solution	9.0	Pure Water	7.0

SALTS

Salts are the ionic compounds consisting of two parts, one part carrying a positive charge called positive ion or cation and the other part carrying a negative charge called a negative ion or anion.

Some common salts

1. Sodium chloride (NaCl)
2. Sodium sulphate (Na_2SO_4)
3. Potassium nitrate (KNO_3)
4. Copper sulphate ($CuSO_4$)
5. Zinc sulphate ($ZnSO_4$)
6. Calcium carbonate ($CaCO_3$)
7. Calcium chloride ($CaCl_2$)
8. Aluminium sulphate [$Al_2(SO_4)_3$]

Salts are formed when acids reacts with bases

Types of Salts

(i) The salts of 'hydrochloric acid' are called **'chlorides'.**
(ii) The salts of 'sulphuric acid' are called **'sulphates',**
(iii) The salts of 'nitric acid' are called **'nitrates'.**
(iv) The salts of 'carbonic acid' are called **'carbonates'.**
(v) The salts of 'acetic acid' are called **'acetates'** and so on.

Do You Know?
The nature of a salt is found by certain chemical tests. The method is called "Qualitative Analysis".

ACTIVITY - 10

Aim: To find the pH of the given salt solutions.

Method:

(i) Collect the following salt samples:
- (a) Sodium chloride
- (b) Potassium nitrate
- (c) Aluminium chloride
- (d) Zinc sulphate
- (e) Copper sulphate
- (f) Sodium acetate
- (g) Sodium carbonate
- (h) Sodium hydrogen carbonate

(ii) Check their solubility in water (use distilled water only).
(iii) Check the action of these solutions on litmus and find the pH using a pH paper.
(iv) Report your observations in a tabular form.

Now answer

(i) Which of the salts are acidic, basic or neutral?
(ii) Identify the acid or base used to form the salt.

Salt	Formula	Solubility in water	Action on litmus	pH	Acid used	Base used
Sodium chloride	NaCl	Soluble	No reaction	7	HCl	NaOH
Potassium nitrate	KNO_3	Soluble	No reaction	7	HNO_3	KOH
Aluminium chloride	$AlCl_3$	Soluble	Turns red	< 7	HCl	$Al(OH)_3$
Zinc sulphate	$ZnSO_4$	Soluble	Turns red	< 7	H_2SO_4	$Zn(OH)_2$ or ZnO
Copper sulphate	$CuSO_4$	Soluble	Turns red	< 7	H_2SO_4	$Cu(OH)_2$ or CuO
Sodium acetate	CH_3COONa	Soluble	Turns Blue	> 7	CH_3COOH	NaOH
Sodium carbonate	Na_2CO_3	Soluble	Turns Blue	> 7	H_2CO_3	NaOH
Sodium hydrogen carbonate	$NaHCO_3$	Soluble	Turns Blue	> 7	H_2CO_3	NaOH

◈ CHEMICALS FROM COMMON SALT (NaCl)

1. Sodium Chloride (Common salt/table salt)

We know that hydrochloric acid and sodium hydroxide combine with each other to form sodium chloride (NaCl) which in common language is also known as common salt. This is the salt which you sprinkle on your salads and use in your kitchens. Common salt is an ionic compound of sodium and chlorine $(Na^+Cl^-)_n$.

The main source of common salt (sodium chloride) is the sea water. Sea water contains about 3.5% of soluble salts, the most common of which is sodium chloride (2.7 to 2.9%). Saline water of inland lakes, such as Sambhar lake in Rajasthan is also a good source of common salt. Sodium chloride is also found as rock salt. Beds of rock salt were formed when lakes/seas dried up in past. Common salt act as raw material for making various materials of daily use. Let us discuss some of them.

2. Sodium hydroxide (NaOH) (chlor alkali processes): When electricity is passed through an acidulated **aqueous solution of brine (or sodium chloride)** the salt undergoes decomposition to produce sodium metal at cathode and chlorine gas at anode. The sodium metal then reacts with water to form sodium hydroxide and evolves hydrogen gas at cathode.

$$NaCl\ (aq) \xrightarrow{\text{Electricity}} Na^+\ (aq) + Cl^-\ (aq)$$

At cathode:

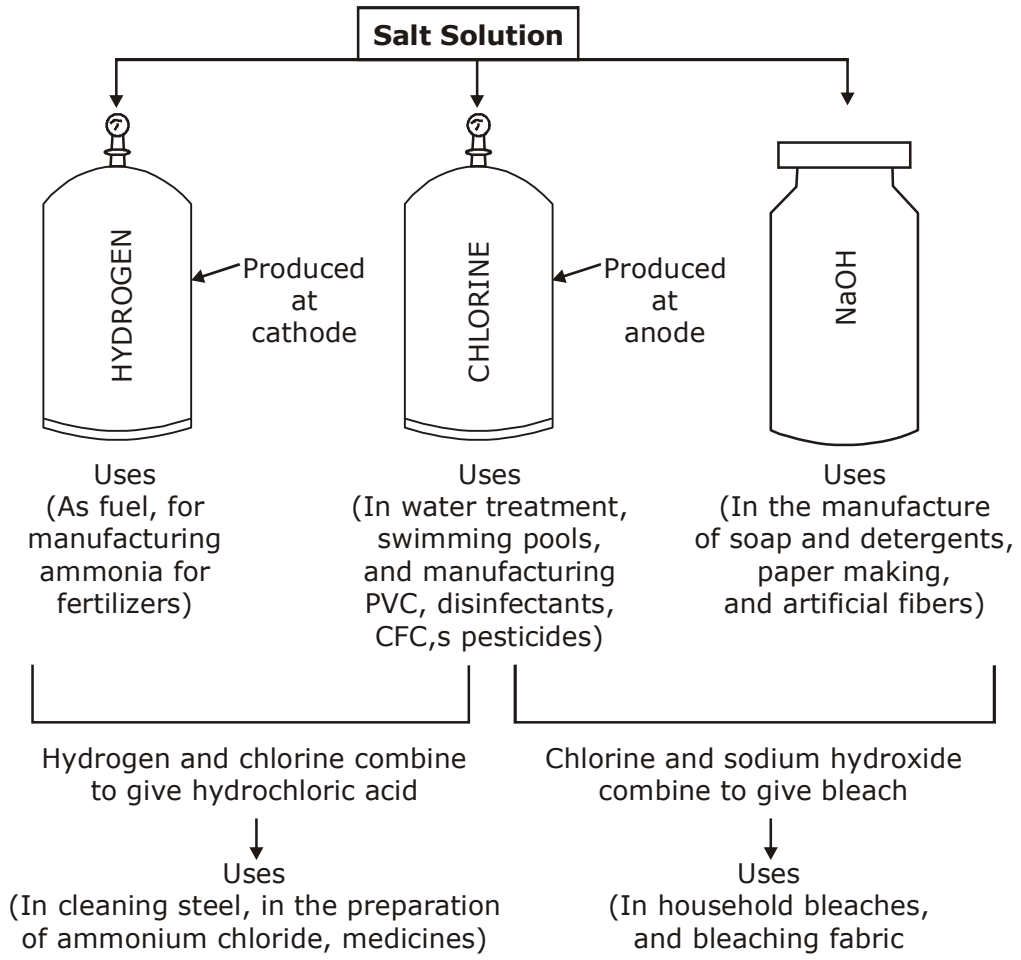
$$Na^+\ (aq) + e^- \longrightarrow Na(s)$$

$$2\ Na(s) + 2\ H_2O \longrightarrow 2\ NaOH(aq) + H_2(g)$$

At anode:

$$Cl^-\ (aq) \longrightarrow Cl + e^-$$

$$2\ Cl \longrightarrow Cl_2\ (g)$$



3. **Bleaching powder ($CaOCl_2$):** The chlorine gas (obtained during the electrolysis of brine) is passed through dry slaked lime [$Ca(OH)_2$], then bleaching powers ($CaOC_2$) is obtained.

$$Ca(OH)_2(s) + Cl_2(g) \longrightarrow CaOCl_2(s) + H_2O(l)$$

Dry slaked lime — Calcium oxychloride (Bleaching powder)

Uses:

(i) For disinfecting (or sterlizing) water (making water free of germs).

(ii) As a germicide and deodorant in medicine.

(iii) For rendering wool unshrinkable.

(iv) For laboratory preparation of chlorine and oxygen.

(v) In the manufacture of chloroform.

(vi) For bleaching, cotton and linen in the textile industry and wood pulp in paper factories and for bleaching wahed clothes in laundary.

4. **Baking soda (or sodium hydrogen carbonate, $NaHCO_3$):** Is prepared by passing carbon dioxide gas through a cold saturated solution of sodium carbonate.

$$Na_2CO_3 + H_2O + CO_2 \xrightarrow{\text{In cold}} 2\,NaHCO_3$$

sodium carbonate — Sodium hydrogen carbonate

Due to its low solubility in cold water, it separates out as white crystals. It is also the primary product of the Solvay process.

Uses:

(i) As an ingredient in antacid medicines, since it is alkaline in nature and neutralizes excess acid in the stomach.

(ii) In cooking food in the form of baking powers, which contains sodium hydrogen carbonate and an acid like tartaric acid (or salt of tartaric acid such as potassium hydrogen tartarate). When baking powder is either dissolved in water or heated, its constituent sodium hydrogen carbonate undrgoes decomposition to liberate carbon dioxide, which causes the bread and cake to rise. Tartaric acid present in the baking powder neutralizes sodium carbonate.

$$2\ NaHCO_3 \xrightarrow{Heat} Na_2CO_3 + H_2O + CO_2$$

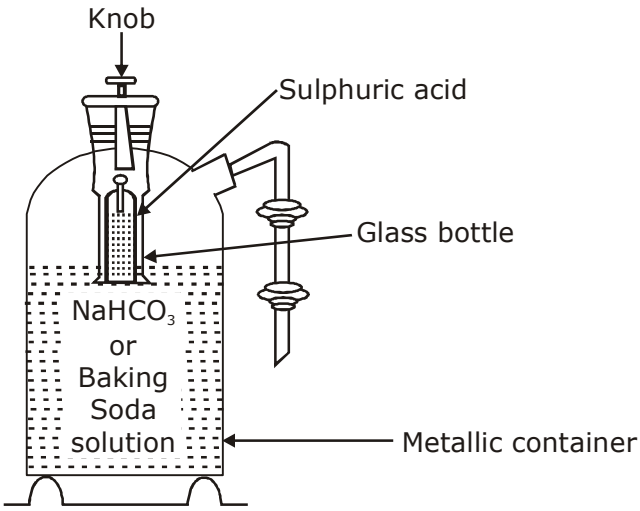
Na_2CO_3 + Tartaric acid $\longrightarrow$ Neutralization

If tartaric acid (or its acidic salt) is not present in the baking powder, then the cake/bread will taste bitter, due to the presence of sidum carbonate.

(iii) In soda-acid fire extinguisher, which contains a solution of sodium hydrogen carbonate surrounding a glass bottle containing sulphuric acid. In case of fire, the knob (provided at the top of extinguisher) is pressed, thereby bottle breaks and the two solutions come in contract, thereby liberating carbon dioxide gas.

$$2\ NaHCO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2\ H_2O + 2\ CO_2$$

The liberated carbon dioxide forces a stream of effervescing liquid on the fire. In this way, carbon dioxide surrounds the combustible substances and cut-off the supply of air, thereby it assits to put out the fire.



Soda-acid fire extinguisher

(iv) In effervescent cold drinks and fruit salts (e.g. Eno).

5. **Sodium carbonate or washing soda, Na_2CO_3. 10 H_2O:** Is manufactured by **solvay process**. The raw materials employed are sodium chloride (NaCl), limestone ($CaCO_3$) and ammonia (NH_3). Actually, most of the ammonia is recovered in the process itself. In this process:

Step I: A cold and concentrated solution of sodium chloride (called brine) is saturated with ammonia to get ammoniacal brine.

Step II: The ammoniacal brine is fed from the top of carbonating tower, which is provided with perforated plates. As the ammoniacal brine trickles down this tower, upcoming carbon dioxide reacts with ammoniacal brine to form insoluble precipitate of sodium hydrogen carbonate (or sodium bicarbonate, $NaHCO_3$). Thus:

$$\underbrace{NaCl + NH_3 + H_2O + CO_2}_{\text{Ammoniacal brine}} \longrightarrow \underbrace{NaHCO_3(s) + NH_4Cl}_{\text{Sodium bicarbonate (ppt.)}}$$

The sodium hydrogen carbonate is filtered; while ammonium chloride is recycled in step I to prepare ammonia.

Step III: Sodium hydrogen carbonate precipitate is heated to get soda ash (sodium carbonate).

$$2\ NaHCO_3 \xrightarrow{Heat} \underset{\text{Soda ash (Sodium carbonate)}}{Na_2CO_3} + H_2O + CO_2$$

The CO_2 is recycled to step (II).

Step IV: The soda ash (Na_2CO_3) so-obtained is dissolved in water and crystallized to get washing soda.

$$\underset{\text{Soda ash}}{Na_2CO_3} + 10\ H_2O \xrightarrow{Crystallization} \underset{\text{Washing soda}}{Na_2CO_3 \cdot 10\ H_2O}$$

It dissolves in water to give alkaline solution. So its aqueous solution turns red litmus blue.

Uses:

(i) For washing purposes in the laundry.

(ii) For softening hard water.

(iii) As a laboratory regent.

(iv) For manufacturing fusion mixture ($Na_2CO_3 + K_2CO_3$), borax, sodium phosphate, glass, soap etc.

6. Plaster of Paris, $CaSO_4 . ½H_2O$: Is prepared by heating gypsum ($CaSO_4 . 2H_2O$) at 373 K in a kiln.

$$2\ [CaSO_4 . 2H_2O] \xrightarrow{373K} \underset{\text{Plaster of Paris}}{[CaSO_4 . ½H_2O]} + 3\ H_2O$$

Gypsum

It may be pointed that heating should be carried our carefully at controlled temperature of 373 K. If temperature of heating exceeds 373 K, there is every possibility of formation of anhydrous calcium sulphate ($CaSO_4$), which possesses no property of Plaster of Paris.

Properties:

(i) A white powder, which abosrbs water with evolution of heat.

(ii) Plaster of Paris ($CaSO_4 . ½H_2O$) possesses the property of "setting up" on mixing with water. During this process, heat is evolved and the material quickly sets with a little expansion. The setting of Plaster of Paris is due to its hydration to gypsum.

$$\underset{\text{Plaster of Paris}}{2\ [CaSO_4 . ½H_2O]} + 3\ H_2O \longrightarrow \underset{\text{Gypsum}}{2\ [CaSO_4 . 2\ H_2O]}$$

Do You Know?
Anhydrous calcium sulphate ($CaSO_4$) is also known as dead burnt plaster

Uses:

(i) For making casts for statues, metals etc.

(ii) In orthopedic to maintain bone joints in fixed position.

(iii) In making wall-boards.

(iv) As a fire-proofing material.

(v) For making smooth the surfaces of walls, ceilings, etc. This process is known as POP.

(vi) For making ornate designs on walls, ceilings etc.

(vii) For making toys and decorative materials.

(viii) In laboratories and industries for sealing the air gap in apparatus/equipment so as to make it air tight.

Q. There will not be any change in the colour of the pH paper because NaCl is a neutral salt.

Are the crystals of salts really dry?

Crystals of some salts contain certain amount of associated water.

The water associated with the crystal (or molecule) of any salt is called water of crystallisation.

The salt containing water of crystallisation are called **hydrated salts.**

ACTIVITY - 11

Aim: To test the presence of water of crystallisation in copper sulphate crystals.

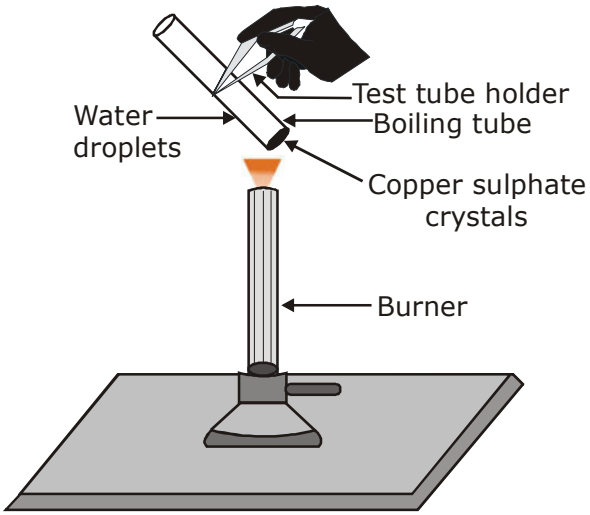
Method:

(i) Heat a few crystals of copper sulphate in a dry boiHng tube.

(ii) Note the colour of copper sulphate after heating.

(iii) Observe the water droplets in the boiling tube.

(iv) Add 2-3 drops of water on the sample of copper suiphate obtained after heating.



Removing water of crystallisation

Now Answer

(i) What do you observe on heating blue copper sulphate crystals?

(ii) Is the blue colour of copper sulphate restored on adding water?

Discussion

Blue coloured copper sulphate crystals heating leave behind white anhydrous copper sulphate and water droplets are seen in the upper cooler parts of the boiling tube. On adding 2-3 drops of water to the white residue. blue colour reappears.

Conclusion

Copper sulphate crystals on heating lose water to form white anhydrous copper sulphate which combines with water to form blue coloured copper sulphate crystals.

Why plaster of Paris cannot be employed ad drying agent?

Anhydrous calcium sulphate ($CaSO_4$) takes up water readily, forming hydrated salt, gypsum.

$$CaSO_4 + 2\ H_2O \longrightarrow \underset{\text{Gypsum}}{CaSO_4 \cdot 2\ H_2O}$$

On the other hand, plaster of Paris sets on addition of water. So it cannot be used as a drying agent.

Water of Crystallisation

It is the fixed number of water molecules present in one formula unit of a crystalline salt, e.g..,

Blue vitriol	$CuSO_4 . 5H_2O$	Green vitriol	$FeSO_4 . 7H_2O$
Glauber's salt	$Na_2SO_4 . 10H_2O$	White vitriol	$ZnSO_4 . 7H_2O$
Gypsum	$CaSO_4 . 2H_2O$	Epsom salt	$MgSO_4 . 7H_2O$

SOLVED PROBLEMS

Ex.1 Give two physical characteristics each of acids and bases ?

Sol. **Acids are**

(i) Sour in taste **(ii)** Change the colour of blue litmus to red.

Base are

(iii) Bitter in taste **(iv)** Change the colour of red litmus to blue.

Ex.2 What are indicators ? Name four acid - base indicators and mention their colour change ?

Sol. Indicators are chemical substances which give different colours in acidic or basic solutions :

(i) Methyl Orange gives orange colour with acid solution and yellow colour with base solution.

(ii) Phenolphthalein is colourless in acid solution while it turns into pink colour in base solution.

(iii) Litmus solution turns red in acid solution and blue in base solution.

(iv) Bromothymol blue is blue in base solution and is yellow in acid solution.

Ex.3 What are antacids ?

Sol. Antacids are mild alkalies and contain sodium hydrogen carbonate. These are used for getting relief from acidity and indigestion and sometimes, even headache. When taken orally, it reacts with hydrochloric acid present in the stomach and reduces its strength by consuming some of it. **For example**, Milk of Magnesia (MgO).

Ex.4 What are olfactory indicators ?

Sol. Olfactory indicators are substances which have different odour in acid and base solutions, **For example** vanilla essence and clove oil.

Ex.5 What is a neutralization reaction ? Give some example.

Sol. When the effect of a base is nullified by an acid and vice versa, it is called neutralization reaction. In general, a neutralization reaction is written as :

$$\text{Base} + \text{Acid} \longrightarrow \text{Salt} + \text{Water}$$

Examples :

(i) Aqueous solution of base, NaOH is neutralized by aqueous hydrochloric acid

$$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O$$

(ii) Aqueous solution of sulphuic acid is neutralized by aqueous solution of sodium hydroxide.

$$H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O$$

Ex.6 When hydrochloric acid is added to marble pieces, a gas (A) is evolved. On passing gas A through lime water, a white precipitate of (B) is formed. When excess of A is passed B dissolves due to the formation of soluble C. Identify A, B and C. Explain the reaction.

Sol. **A.** Carbon dioxide

B. Calcium carbonate

C. Calcium hydrogen carbonate

Chemical reaction

Marble is calcium carbonate. It reacts with HCl to give CO_2

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

CO_2 when passed through lime water $[Ca(OH)_2]$ gives a while precipitate of $CaCO_3$

$$Ca(OH)_2 + CO_2(g) \longrightarrow CaCO_3(s) + H_2O$$

On passing excess CO_2, $CaCO_3$ dissolves forming soluble $Ca(HCO_3)_2$

$$CaCO_3 + CO_2 \xrightarrow{+H_2O} Ca(HCO_3)_2(aq)$$

Calcium hydrogen carbonate

Ex.7 Name four acids and bases. Write their formulate.

Sol.

Acids			**Bases**		
(i) Hydrocholoric acid	-	HCl	**(i)** Sodium hydroxide	-	$NaOH$
(ii) Sulphuric acid	-	H_2SO_4	**(ii)** Calcium hydroxide	-	$Ca(OH)_2$
(iii) Nitric acid	-	HNO_3	**(iii)** Ammonium hydroxide	-	NH_4OH
(iv) Acetic acid	-	CH_3COOH	**(iv)** Magnesium hydroxide	-	$Mg(OH)_2$

Ex.8 Mention important characteristics of acids.

Sol. Characteristics of acids :

(i) They are sour in taste.

(ii) They turn blue litmus to red.

(iii) Acids react with metals to envolve hydrogen gas.

$2HCl + Mg \longrightarrow MgCl_2 + H_2(g)\uparrow$

$H_2SO_4 + Zn \longrightarrow ZnSO_4 + H_2(g)\uparrow$

$2HCl + 2Na \longrightarrow 2NaCl + H_2(g)\uparrow$

(iv) Acids react with bases to form salt and water. This is called neutralisation.

$HCl + NaOH \longrightarrow NaCl + H_2O$

$H_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + 2H_2O$

(v) Acids react with basic oxides to form salt and water.

$CaO + 2HCl \longrightarrow CaCl_2 + H_2O$

$Na_2O + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

(vi) Acid react with carbonate to form salt, water and CO_2

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2\uparrow$

$MgCO_3 + H_2SO_4 \longrightarrow MgSO_4 + H_2O + CO_2\uparrow$

Ex.9 A solution turns red litmus paper blue. What does this indicate about the chemical nature of the solution ?

Sol. The changing colour of litmus from blue to red is a characteristics of the substances called bases or alkalis.

Metal hydroxide like potassium hydroxide change the colour of red litmus to blue litmus.

Ex.10 What are bases ? Give the characteristics of bases.

Sol. Bases are the hydroxide of metals which give hydroxide ion after dissociation in aequeous solution.

Characteristic of bases

(i) They are bitter in taste.

(ii) They change red litmus to blue.

(iii) They react with acids to form salt and water.

(iv) Bases are soluble in water and are known as alkalies.

Ex.11 How do you measure the strength of an acid or a base ?

Sol. The strength of an acid or a base depends on the number of H^+ ions or OH^- ions produced respectively by its given amount. If we take one molar concentration (1 mole dissolved in 1 litre) of hydrochloric acid and acetic acid, then the acid which gives rise to more of H^+ ions is a stronger acid and the one that gives less H^+ ions is a weaker acid. In this case, it is found that hydrocholoric acid is a strong acid. Similarly one can find whether it is a strong base or a weak base. (Here number of OH^- ions is counted).

Ex.12 1 mole per litre of (A) has pH equal to 13 and 1 mole per litre of (B) has pH equal to 11. Which is stronger ? Whether these are bases or acids ?

Sol. Both A and B are bases since their pH values are more than 7. Since both have equal concentration and the pH of A is more than that of B, A is a stronger base than B.

Ex.13 A group of students measured the pH of some substance they found in their home. Their results are given in the table below :

Substance	**pH**
Apples	3.0
Black coffee	8.5
Lemon juice	2.5
Milk	6.5
Sugar	7.0
Toothpaste	9.0
Vinegar	3.0
Washing soda	11.5

(i) Which solution is the most acidic ?

(ii) Which solution is the most basic ?

(iii) Which substance is the neutral ?

Sol. **(i)** Lemon juice **(ii)** Washing soda **(iii)** Sugar

Ex.14 What is acid rain. How does it affect our aquatic life ?

Sol. When the pH of rain water is less than 5.6, it is called acid rain. When acid rain flows in to the rivers, it lowers the pH of the river water. Since our body works within a narrow pH range close to 7, the survival of aquatic life in river waters mixed with rain water becomes difficult.

Ex.15 The tanks in which milk is stored for retail selling are cleaned with sodium hydroxide solution everytime fresh milk is filled in them. Give the reason for this practice.

Sol. Milk contains lactic acid and its effect remains in the empty tank. The acidic effect in the tank can be neutralized by cleaning with it with a solution of a base, e.g., NaOH. It changes the acid into salt which then gets removed from the tank by cleaning with water.

NCERT QUESTIONS WITH SOLUTIONS

Q.1 You have been provided with three test tubes. One of them contains distilled water and the other two contain an acidic solution and a basic solution, respectively. If you are given only red litmus paper. how will you identify the contents of each test tube?

Ans. **Step 1:** Let us mark the three test tubes as A, B and C.

Step 2: A drop of the solution in test tube A is put on the red litmus paper. Same is repeated with solution Band C. If either of them changes colour to blue, then it is basic. Therefore, out of three, one is eliminated.

Step 3: Out of the remaining two, anyone can be acidic or neutral. Now a drop of basic solution is mixed with a drop of each of the remaining two solutions separately and then a drop of each solution is put on the red litmus paper. If the colour of red litmus turns blue, then that solution is neutral and if there is no cha.nge in colour, then that solution is acidic. This is because acidic and basic solutions neutralise each other. Hence, we can distinguish between the three types of solutions.

Q.2 Why should curd and sour substances not be kept in brass and copper vessels?

Ans. Curd and other sour substances contain acids. Therefore, when they are kept in brass and copper vessels, the metal reacts with the acid to liberate hydrogen gas and harmful products, thereby spoiling the food.

Q.3 Which gas is usually liberated when an acid reacts with a metal? Illustrate with an example. How will you test for the presence of this gas?

Ans. Hydrogen gas is usually liberated when an acid reacts with a metal.

Example : Procedure :

Step 1: Take few pieces of zinc granules and add 5 ml of dilute H_2SO_4 .

Step 2 : Shake it and pass the gas produced into a soap solution. The bubbles are formed in the soap solution. These soap bubbles contain hydrogen gas. Test for hydrogen gas: The evolved hydrogen gas can be tested by bringing a burning candle near the soap bubbles. Hydrogen gas burns with a pop sound.

Q.4 Metal compound A reacts with dilute hydrochloric acid to produce effervescence. The gas evolved extinguishes a burning candle. Write a balanced chemical equation for the reaction if one of the compounds formed is calcium chloride.

Ans. $CaCO_3(s) + 2HCl(aq) \longrightarrow CaCl_2(s) + CO_2(g) + H_2O(\ell)$

Q.5 Why do HCl, HNO_3, etc., show acidic character in aqueous solution while solutions of compounds like alcohol and glucose do not show acidic character?

Ans. HCl and HNO_3 dissociate in the presence of water to form hydrogen or hydronium ions. Although aqueous solutions of glucose and alcohol contain hydrogen, these cannot dissociate in water to form hydrogen or hydronium ions. Hence, they do not show acidic character.

Q.6 Why does an aqueous solution of an acid conduct electricity?

Ans. Acids dissociate in aqueous solutions to form ions. These ions are responsible for conduction of electricity.

Q.7 Why does dry HCl gas not change the colour of the dry litmus paper?

Ans. Dry HCl gas does not change the colour of the dry litmus paper because it does not contain H^+ ions.

Q.8 While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?

Ans. It is recommended that the acid should be added to water and not water to the add because the process of dissolving an acid in water is exothermic.If water is added to acid. since large amount of acid is present, a large amount of heat is generated. therefore, the mixture splasnes out and causes burns.

Q.9 How is the concentration of hydronium ions (H_3O^+) affected when a solution of an acid is diluted?

Ans. When an acid is diluted, the concentration of hydronium ions (H_3O^+) per unit volume decreases. This means that the strength of the acid decreases.

Q.10 How is the concentration of hydroxide ions (OH^-) affected when excess base is dissolved in a solution of sodium hydroXide ?

Ans. The concentration of hydroxide ions (OH^-) would increase when excess base is dissolved in a solution of sodium hydroxide.

Q.11 You have two solutions, A and B. The pH of solution A is 6 and pH of solution B is 8. Which solution has more hydrogen ion concentration? Which of this is acidic and which one is basic ?

Ans. A pH value of less than 7 indicates an acidic solution, while greater than 7 indicates a basic solution. Therefore, the solution with pH 6 is acidic and has more hydrogen ion concentration than the solution of pH 8 which is basic.

Q.12 What effect does the concentration of $H^+(aq)$ ions have on the nature of then solution ?

Ans. If the concentration of H^+ ions is increased, the solution becomes more acidic. If the concentration of H^+ ions is decreased, the solution becomes less acidic or more basic.

Q.13 Do basic solutions also have $H^+(aq)$ ions? If yes, then why are these basic ?

Ans. Yes, a basic solution also has $H^+(aq)$ ions. However, their concentration is less as compared to the concentration of $OH^-(aq)$ ions which makes the solution basic.

Q.14 Under what soil condition do you think a farmer would treat the soil of his fields with quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate) ?

Ans. If the soil is acidic and improper for cultivation, then to neutralise the acidity of the soil, the farmer would treat the soil with quick lime or slaked lime or chalk.

Q.15 What is the common name of the compound $CaOCl_2$.

Ans. The common name of the compound $CaOCl_2$ is bleaching powder.

Q.16 Name the substance which on treatment with chlorine yields bleaching powder?

Ans. Calcium hydroxide [$Ca(OH)_2$], on treatment with chlorine, yields bleaching powder.

Q.17 Name the sodium compound which is used for softening hard water.

Ans. Washing soda ($Na_2CO_3.10\ H_2O$) is used for softening hard water.

Q.18 What will happen if a solution of sodium hydrogen carbonate is heated? Give the equation of the reaction involved.

Ans. When a solution of sodium hydrogencarbonate is heated, sodium carbonate and water are formed With the evolution of carbon dioxide gas.

$$\underset{\text{Sodium hydrogen carbonate}}{2NaHCO_3} \xrightarrow{\Delta} \underset{\text{Sodium carbonate}}{Na_2CO_3} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon dioxide}}{CO_2\uparrow}$$

Q.19 Write an equation to show the reaction between Plaster of Paris and water.

Ans. The chemical equation for the reaction of Plaster of Paris and water can be represented as:

$$\underset{\text{Plaster of Paris}}{CaSO_4.\frac{1}{2}H_2O} + \underset{\text{Water}}{1\frac{1}{2}H_2O} \longrightarrow \underset{\text{Gypsum}}{CaSO_4.2H_2O}$$

Q.20 A solution turns red litmus blue, its pH is likely to be

(1) 1 (2) 4 (3) 5 (4) 10

Ans. (4) 10

Q.21 A solution reacts with crushed egg-shells to give a gas that turns lime-water milky. The solution contains

(1) NaCl (2) HCl (3) LiCl (4) KCl

Ans. (2) HCl

Q.22 10 mL of a solution of NaOH is found to be completely neutralised by 8mL of a given solution of HCl. If we take 20 mL of the same solution of NaOH, the amount of HCl solution (the same solution as before) required to neutralise it will be

(1) 4 mL (2) 8mL (3) 12 mL (4) 16 mL

Ans. (4) 16 mL

Q.23 Which one of the follwing types of medicines is used for treating indigestion ?

(1) Antibiotic (2) AnalgesiC (3) Antacid (4) Antiseptic

Ans. (3) Antacid

Q.24 Write word equations and then balanced equations for the reaction taking place when

(1) Dilute sulphuric acid reacts with zinc granules.

(2) Dilute hydrochloric add reacts with magnesium ribbon.

(3) Dilute sulphuric acid reacts with aluminium powder.

(4) Dilute hydrochloric acid reacts with iron filings.

Ans. (1) Sulphuric acid + zinc $\longrightarrow$ Zinc sulphate + Hydrogen

$H_2SO_4(aq) + Zn(s) \longrightarrow ZnSO_4(aq) + H_2(g)$

(2) Hydrochloric acid + Magnesium $\longrightarrow$ Magnesium chloride + Hydrogen

$2HCl(aq) + Mg(s) \longrightarrow MgCl_2(aq) + H_2(g)$

(3) Sulphuric acid + Aluminium $\longrightarrow$ Aluminium sulphate + Hydrogen

$3H_2SO_4(aq) + 2Al(s) \longrightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$

(4) Hydrochloric acid + Iron $\longrightarrow$ Ferric chloride + Hydrogen

$6HCl(aq) + 2Fe(s) \longrightarrow 2FeCl_3(aq) + 3H_2(g)$

Q.25 Compounds such as alcohols and glucose also contain hydrogen but are not categorized as acids. Describe an activity to prove it.

Ans. Acitivity : Procedure :

Step 1: Two nails are fitted on a cork and are kept it in a 100 mL beaker.

Step 2: The nails are then connected to the two terminals of a 6-volt battery through a bulb and a switch.

Step 3: Some dilute HCl is poured in the beaker and the current is switched on.

Step 4: The same experiment is then performed with glucose solution and alcohol solution.

Observations: glows in the HCl solution and does not glow In the glucose solution and alcohol solution. Result: HCl dissociates into H^+ (aq) and C!iaq) ions. These ions conduct electricity in the solution which results in the glowing of the bulb. On the other hand, the glucose solution and alcohol solution does not dissociate into ions. Therefore, it does not conduct electricity.

Conclusion: From this activity, it can be concluded that all acids contain hydrogen but not all compounds containing hydrogen are acids.

That is why, though alcohols and glucose contain hydrogen, they are not categorised as acids.

Q.26 Why does distilled water not conduct electricity, whereas rain water does?

Ans. Distilled water is a pure form of water and is devoid of any ionic species. Therefore, it does not conduct electricity. Rain water, being an impure form of water, contains many ionic species such as acids and therefore it conducts electricity.

Q.27 Why do acids not show acidic behaviour in the absence of water?

Ans. Acids do not show acidic behaviour in the absence of water because there are no hydrogen ions available for conduction of electricity. Acids dissociate in the presence of water to give free hydrogen ions. It is the hydrogen ions that are responsible for the acidic behaviour.

Q.28 Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9, respectively. Which solution is

(a) neutral ? (b) strongly alkaline ? (c) strongly acidic?

(d) weakly acidic ? (e) weakly alkaline ?

Arrange the pH in increasing order of hydrogenion concentration.

Ans. (a) Neutral - Solution D with pH 7

(b) Strongly alkaline - Solution C with pH 11

(c) Strongly acidic - Solution B with pH 1

(d) Weakly acidic - Solution A with pH 4

(e) Weakly alkaline - Solution E with pH 9

The pH can be arranged in the increasing order of the concentration of hydrogen ions as:

$11 < 9 < 7 < 4 < 1$.

Q.29 Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid (HCl) is added to test tube A. while acetic acid (CH_3COOH) is added to test tube B. In which test tube will the fizzing occur more vigorously and why?

Ans. The fizzing will occur strongly in test tube A, in which hydrochlOric acid (HCl) is added. This is because HCl is a stronger acid than CH_3COOH and therefore produces hydrogen gas at a faster speed due to which fizzing occurs.

Q.30 Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain your answer.

Ans. The pH of milk is 6. As it changes to curd, the pH will reduce because curd is acidic in nature. The acids present in it decrease the pH.

Q.31 A milkman adds a very small amount of baking soda to fresh milk.

(a) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?

(b) Why does this milk take a long time to set as curd?

Ans. (a) The milkman shifts the pH of the fresh milk from 6 to slightly alkaline because in alkaline condition, milk does not set as curd easily.

(b) Since this milk is slightly basic than usual milk, acids produced to set the curd are neutralised by the base. Therefore, it takes a longer time for the curd to set.

Q.32 Plaster of Pans should be stored in a mOisture-proof container. Explain why?

Ans. Plaster of Paris should be stored in a moisture-proof container because Plaster of Paris. a powdery mass, absorbs water (moisture) to form a hard solid known as gypsum.

Q.33 What is a neutralisation reaction ? Give two examples.

Ans. A reaction in which an acid and base react with each other to give a salt and water is termed as neutralisation reaction. In this reaction, energy is evolved in the form of heat.

For example:

(i) $NaOH + HCl \longrightarrow NaCl + H_2O$

Base Acid Salt Water

(ii) During indigestion (casued due to the production of excess of hydrochloric acid in the stomach), we administer an antacid (generally milk of magnesia, $Mg(OH)_2$ which is basic in nature). The antacid neutralises the excess of acids and thus gives relief from indigestion.

$Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$

Q.34 Give two important uses of washing soda and baking soda.

Ans. Two important uses of washing soda and baking soda are as follows:

(1) Washing soda :

(a) It is used in glass, soap, and paper industries.

(b) It is used to remove permanent hardness of water.

(2) Baking soda:

(a) It is used as baking powder. Baking powder is a mixture of baking soda and a mild acid known as tartaric acid. When it is heated or mixed in water, it releases CO_2 gas that makes bread or cake fluffy.

(b) It is used in soda-acid fire extinguishers.

EXERCISE – I BOARD PROBLEMS

Q.1 What happens when
(a) Baking soda is heated
(b) Blue colour copper sulphate crystals are heated
(c) Water is added to lime?

Q.2 A white powder which sets hard on adding water is also used in hospitals. Name this powder. How is it prepared? Write the chemical reaction involved in its preparation

Q.3 Write balanced chemical equations for the following;
(a) Calcium carbonate reacts with hydrochloric acid
(b) dilute sulphuric acid reacts with Zinc granites
(c) Calcium oxychloride reacts with hydrochloric acid

Q.4 Name the ions present in the following salts. Name the acid and base from which they can be obtained. Magnesium sulphate, sodium carbonate, potassium chloride.

Q.5 Give three ways in which salts can be prepared,

Q.6 Give one example for each of the following acids salts chloride salts, carbonate salts, sulphate salts.

Q.7 Name the acid present in the following.
Vinegar; Lemon, Tomoto, Tamarind, orange, curd.

Q.8 Acid when react with metals release hydrogen gas but there is one acid which when reacts with metals and does not release hydrogen except for two metals. Prove this statement.

Q.9 When carbon dioxide is bubbled into limewater, a white cloud appears.
(i) Write an equation to show the reaction between limewater and water.
(ii) Name and write the formula of the product.
(iii) What is the chemical name for limewater.
(iv) Write the equation for the chemical reaction between lime water, water and CO_2

Q.10 Why does common salt become moist in rainy season.

Or

Ordinary common salt contains another substance which is deliquescent. Name the substance and write its formula.

Q.11 An alkali is an important base used for the laboratory work. Name the base and state how it can be prepared from common salt ?

Q.12 Give the different commercial forms of sodium carbonate.

Q.13 What is efflorescence ?

EXERCISE – II OLYMPIAD QUESTIONS

Q.1 A solution turns red litmus blue, its pH is likely to be–
(A) 1 (B) 4
(C) 5 (D) 10

Q.2 A solution reacts with crushed egg-shells to give a gas that turns lime-water milky. The solution contains–
(A) NaCl (B) HCl
(C) LiCl (D) KCl

Q.3 Which one of the following types of medicines is used for treatment indigestion–
(A) Antibiotic (B) Analgesic
(C) Antacid (D) Antiseptic

Q.4 According to Arrhenius acid gives –
(A) H^+ in water (B) OH^- in water
(C) Both (A) & (B) (D) OH^- in acid medium

Q.5 Milk of magnesia is an –
(A) Acid (B) Antacid
(C) Alkali (D) Rock salt

Q.6 Noble metals are dissolved in –
(A) Conc. HNO_3 (B) Conc. HCl
(C) Conc. H_2SO_4 (D) Aqua-regia

Q.7 Which of the following is not a strong acid?
(A) H_2SO_4 (B) CH_3COOH
(C) HNO_3 (D) HCl

Q.8 Soda ash is –
(A) $Na_2CO_3 \cdot H_2O$ (B) Na_2CO_3
(C) NaOH (D) $NaHCO_2$

Q.9 Which of the following method is not used in preparing a base?
(A) Burning of metal in air.
(B) Adding water to a metal oxide.
(C) Reaction between an acid and base.
(D) Heating metal carbonates.

Q.10 Fats + NaOH $\longrightarrow$ .....+ Glycerol. One of the product formed in this reacton is –
(A) Soap (B) Cloth
(C) Paper (D) Wood

Q.11 Potash alum is a ?
(A) Simple salt (B) Complex salt
(C) Acid salt (D) Double salt

Q.12 $NaHCO_3$ represent the formula of which one of the following ?
(A) Sodium carbonate
(B) Baking soda
(C) Sodium acetate
(D) Washing soda

Q.13 _____ acid is responsible for the 'fizz' in soft drinks. **[NTSE]**
(A) Oxalic (B) Acetic
(C) Citric (D) Carbonic

Q.14 A base can be prepared by the reaction between _____. **[NTSE]**
(A) an active non-metal and water
(B) a gas and water
(C) a sulphide and water
(D) an active metal and water

Q.15 Identify the base in the given reaction:
$HI + H_2O \longrightarrow H_3O^+ + I^-$. **[NTSE]**
(A) HI (B) H_2O
(C) H_3O^- (D) I^-

Q.16 In the following reaction, identify the products
$Na_2CO_3(aq) + 2HCl\ (aq) \longrightarrow$ _____ **[NTSE]**
(A) $NaCl + H_2O$
(B) $H_2O + CO_2$
(C) $Na_2CO_3 + CO_2 + H_2O$
(D) $NaCl + CO_2 + H_2O$

Q.17 In the following acid-base neutralisation reaction: **[NTSE]**
$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$ which term best describes the formation of sodium acetate (CH_3COONa)?
(A) Salt (B) Acid
(C) Base (D) Neutralisation agent

Q.18 Which of the following is not a mixed salt? **[NTSE]**
(A) $KCaPO_4$ (B) Ca(OCl)Cl
(C) $NaKCO_3$ (D) KCl

Q.19 The correct order of Lewis acid character is _____. **[NTSE]**
(A) $BH_3 < BCl_3 < BBr_2 < BI_3$
(B) $BCl_3 < BF_3 < BBr_3 < BI_3$
(C) $BBr_3 < BI_3 < BCl_3 < BF_3$
(D) $BF_3 > BCl_3 > BBr_3 > BI_3$

Q.20 Soda water has a pH of _____. **[NTSE]**
(A) less than 7 (B) more than 7
(C) equal to 7 (D) cannot say

Q.21 The fizzing out of gas on opening a soda water bottle is because of _____. **[NTSE]**

(A) increase in the pressure and splitting of gas molecules

(B) decrease in pressure and increase in solubility of gas

(C) decrease in pressure and solubility of gas

(D) increase in pressure of gas leading to evolution of new product

Q.22 In aluminothermite process, aluminium acts as _____. **[NTSE]**

(A) an oxidising agent (B) a flux

(C) a reducing agent (D) a solder

Q.23 Which of the following reactions occur at cathode? **[NTSE]**

(A) $2OH^- \longrightarrow H_2O + O + 2e^-$

(B) $Fe^{2+} \longrightarrow Fe^{3+} + e^-$

(C) $Ag \longrightarrow Ag^+ + e^-$

(D) $Cu^{2+} + 2e^- \longrightarrow Cu$

Q.24 A solution of sodium sulphate in water is electrolysed using inert electrodes. The products at cathodes and anode, respectively, are _____. **[NTSE]**

(A) H_2 and O_2 (B) O_2 and H_2

(C) O_2 and Na (D) O_2 and SO_2

Q.25 The stronger the oxidising agent, greater is the _____. **[NTSE]**

(A) reduction potential

(B) oxidation potential

(C) ionic behaviours

(D) none of the above

Q.26 In the following reaction, identify that salt formed: **[NTSE]**

$2NH_4OH(aq) + H_2SO_4(aq) \longrightarrow$ _____ $+ 2H_2O(l)$

(A) NH_4NO_3 (B) $(NH_4)_2SO_4$

(C) $(NH_4)PO_4$ (D) $(NH_4)_2S$

Q.27 Which of the following salts does not contain water of crystallisation? **[NTSE]**

(A) Blue vitriol (B) Baking soda

(C) Washing soda (D) Gypsum

Q.28 Which of the following gives the correct increasing order of acidic strength? **[NTSE]**

(A) Water < Acetic acid < Hydrochloric acid

(B) Water < Hydrochloric acid < Acetic acid

(C) Acetic acid < Water < Hydrochloric acid

(D) Hydrochloric acid < Water < Acetic acid

Q.29 If a few drops of a concentrated acid accidentally spills over the hand of a student, what should be done? **[NTSE]**

(A) Wash the hand with saline solution

(B) Wash the hand immediately with plenty of water and apply a paste of sodium hydrogencarbonate

(C) After washing with plenty of water apply solution of sdoium hydroxide on the hand

(D) Neutralise the acid with a strong alkali

Q.30 Sodium hydrogencarbonate when added to acetic acid evolves a gas. Which of the following statements are true about the gas evolved? **[NTSE]**

(i) It turns lime water milky

(ii) It extinguishes a burning splinter

(iii) It dissolves in a solution of sodium hydroxide

(iv) It has a pungent odour

(A) (i) and (ii)

(B) (i), (ii) and (iii)

(C) (ii), (iii) and (iv)

(D) (i) and (iv)

Q.31 Common salt besides being used in kitchen can also be used as the raw material for making

(i) washing soda (ii) bleaching powder

(iii) baking soda (iv) slaked lime **[NTSE]**

(A) (i) and (ii) (B) (i), (ii) and (iv)

(C) (i) and (iii) (D) (i), (iii) and (iv)

Q.32 One of the constituents of baking powder is sodium hydrogencarbonate, the other constituent is **[NTSE]**

(A) hydrochloric acid

(B) tartaric acid

(C) acetic acid

(D) sulphuric acid

Q.33 Equal volumes of hydrochloric acid and sodium hydroxide solutions of same concentration are mixed and the pH of the resulting solution is checked with a pH paper. What would be the colour obtained? **[NTSE]**

(A) Red (B) Yellow

(C) Yellowish green (D) Blue

Q.34 Which of the following is(are) true when HCl(g) is passed through water? **[NTSE]**

(A) It does not ionise in the solution as it is covalent compound.

(B) It ionises in the solution

(C) It gives both hydrogen and hydroxyl ion in the solution

(D) It forms hydronium ion in the solution due to the combination

Q.35 Which of the following are present in a dilute aqueous solution of hydrochloric acid? **[NTSE]**

(A) $H_3O^+ + Cl^-$ (B) $H_3O^+ + OH^-$

(C) $Cl^- + OH^-$ (D) unionised HCl

Q.36 Identify the correct representation of reaction occuring during chlorakali process **[NTSE]**

(A) $2NaCl(l) + 2H_2O(l) \longrightarrow 2NaOH(l) + Cl_2(g) + H_2(g)$

(B) $2NaCl(aq) + 2H_2O(aq) \longrightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

(C) $2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + Cl_2(aq) + H_2(aq)$

(D) $2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

Q.37 Which of the following is not an organic acid?

(A) tartaric acid (B) oxalic acid **[NTSE]**

(C) ascorbic acid (D) nitric acid

Q.38 The sharp pain caused by the sting of an ant is due to **[NTSE]**

(A) malic acid (B) nitric acid

(C) formic acid (D) lactic acid

Q.39 The basicity of an acid is defined as **[NTSE]**

(A) the number of replaceable OH^- ions

(B) the number of H^+ ions that can be formed from the acid

(C) the power of the acid to form salts

(D) none of the above

Q.40 Which of the following is not an acidic salt?

(A) $CuSO_4$ (B) Na_2CO_3 **[NTSE]**

(C) $ZnSO_4$ (D) NH_4NO_3

Q.41 Soda water has a pH value **[NTSE]**

(A) > 7 (B) < 7

(C) 7 (D) > 14

Q.42 Many salts absorb water from the atmosphere. This property is called **[NTSE]**

(A) hydration (B) dehydration

(C) deliquescence (D) efforescence

Q.43 Which of the following acid is used by goldsmiths for cleaning gold and silver ornaments? **[NTSE]**

(A) HCl (B) H_2SO_4

(C) HNO_3 (D) H_3PO_4

Q.44 Basic salts are formed by neutralization of

(A) storng acid and strong base **[NTSE]**

(B) strong acid and weak base

(C) weak acid and weak base

(D) strong base and weak acid

ANSWER KEY

1.	D	**2.**	B	**3.**	C	**4.**	A
5.	B	**6.**	D	**7.**	B	**8.**	B
9.	B	**10.**	A	**11.**	D	**12.**	B
13.	D	**14.**	D	**15.**	B	**16.**	D
17.	A	**18.**	D	**19.**	A	**20.**	A
21.	C	**22.**	C	**23.**	D	**24.**	A
25.	A	**26.**	B	**27.**	B	**28.**	A
29.	B	**30.**	A	**31.**	C	**32.**	B
33.	D	**34.**	B	**35.**	A	**36.**	D
37.	D	**38.**	C	**39.**	B	**40.**	B
41.	B	**42.**	C	**43.**	C	**44.**	D

EXERCISE – III ISO / IMO / IJO / NETSES QUESTIONS

1. Which formula represents a salt?

(A) KOH (B) KCl

(C) CH_3OH (D) CH_3COOH

2. Which substance can be classified as an Arrhenius acid?

(A) HCL (B) NaCl

(C) LiOH (D)KOH

3. Which solution will change red litmus to blue?

(A) HCl(aq) (B) NaCl(aq)

(C) CH_3OH(aq) (D) NaOH(aq)

4. An acidic solution could have a pH of

(A)7 (B) 10

(C) 3 (D) 14

5. What is the pH of a 0.00001 molar HCl solution?

(A) 1 (B) 9

(C) 5 (D) 4

6. What is the pH of a solution with a hydronium -ion concentration of 0.01 mole per liter?

(A) 1 (B) 2

(C) 10 (D) 14

7. There are alternate acid base theories that define an acid as any species that can

(A) donate a proton (B) donate an electron

(C) accept a proton (D) accept an electron

8. Which 0.1 M solution will turn phenolphthalein pink?

(A) HBr(aq) (B) CO_2(aq)

(C) LiOH(aq) (D) CH_3OH(aq)

9. Given the equation: H+ + OH- <-> H_2O. Which type of reaction does the equation represent?

(A) esterification (B) decomposition

(C) hydrolysis (D) neutralization

10. When HCl(aq) is exactly neutralized by NaOH(aq), the hydrogen ion concentration in the resulting mixture is

(A) always less than the concentration of the hydroxide ions

(B) always greater than the concentration of the hydroxide ions

(C) always equal than the concentration of the hydroxide ions

(D) sometimes greater and sometimes less than the concentration of the hydroxide ions

11. As the hydrogen ion concentration of an aqueous solution increases, the hydroxide ion concentration of this solution will

(A) decrease
(B) increase

(C) remain the same

(D) firstly increase then decreases

12. A student wishes to prepare approximately 100 milliliters of an aqueous solution of 6M HCl using 12 M HCl. Which procedure is correct?

(A) adding 50 mL of 12 M HCl to 50 mL of water while stirring the mixture steadily.

(B) adding 50 mL of 12 M HCl to 50 mL of water and then stirring the mixture steadily.

(C) adding 50 mL of water to 50 mL of 12 M HCl while stirring the mixture steadily.

(D) adding 50 mL of water to 50 mL of 12 M HCl and then stirring the mixture steadily.

13. The following data were collected at the endpoint of a titration performed to find the molarity of an HCl solution.

Volume of acid (HCl) used = 1(D)4 mL

Volume of base (NaOH) used = 2(B)4 mL

Molarity of standard base (NaOH) = 0.20 M

What is the molarity of the acid solution?

(A) 1.6 M (B) 0.64 M

(C) 0.31M (D) 0.13M

14. In general, salts

(A) are ionic compounds

(B) contain hydrogen ions

(C) contain hydroxide ions

(D) turn litmus red

15. When bases ionize they release

(A) hydrogen ions (B) sodium ions

(C) chloride ions (D) hydroxide ions

16. A base used in the manufacture of soap is

(A) calcium hydroxide (B) sodium hydroxide

(C) ammonium hydroxide

(D) zinc hydroxide

17. An element common to all acids is

(A) chlorine (B) nitrogen

(C) oxygen (D) hydrogen

18. When magnesium and hydrochloric acid react, they produce

(A) oxygen and magnesium chloride

(B) chlorine and magnesium oxide

(C) hydrogen and magnesium chloride

(D) hydrogen and magnesium oxide

19. When water solutions of an acid and base are mixed

(A) no reaction occurs

(B) a new acid and a new base are formed

(C) a salt and water are formed

(D) an acid and a salt are formed

20. A common substance that contains acetic acid is

(A) vinegar (B) ammonia water

(C) salad oil (D) soap

21. Fruit juices, such as orange juice, contain boric acid

(A) True (B) False

(C) Both (A) & (B) (D) None of these

22. When dissolved in water, salts

(A) are nonelectrolytes

(B) have a bitter taste

(C) are electrolytes

(D) release hydrogen ions

23. A base can be prepared by the reaction between

(A) an active nonmetal with water

(B) a gas with water

(C) a sulfide with water

(D) an active metal with water

24. Of the following, the property that most closely relates to acids is

(A) bitter taste

(B) contains the hydroxide polyatomic ion

(C) sour taste

(D) salty taste

25. when an acid is dissolved in water, it usually forms

(A) hydrogen ions (B) hydroxide ions

(C) no ions (D) chloride ions

26. The preparation of hydrochloric acid can be accomplished by heating a mixture of sodium chloride and sodium hydroxide:

(A) True (B) False

(C) Both (A) & (B) (D) None of these

27. The acid used in the storage battery in your car is

(A) nitric acid

(B) hydrochloric acid

(C) tartaric acid

(D) sulphuric acid

28. The sour taste of lemons and limes is due to a substance called

(A) acetic acid (B) citric acid

(C) hydrochloric acid (D) carbonic acid

29. A strong acid in solution is

(A) mostly molecules

(B) mostly ions

(C) both molecules and ions

(D) mostly water

30. The pH of a carbonated drink is

(A) less than 7 (B) more than 7

(C) equal to 7 (D) approximately 7.8

31. An acid is

(A) a proton donor

(B) a proton acceptor

(C) an electron donor

(D) an electron acceptot

32. The drying of milk of lime (white washing) is due to the action of

(A) oxygen in air (B) nitrogen in air

(C) hydrogen in air (D) carbondioxide in air

33. A salt derived from a strong base and a weak acid will give a salt that is

(A) acidic (B) basic

(C) neutral (D) volatile

34. When litmus is added to a solution of borax it turns

(A) red (B) pink

(C) remain colourless (D) blue

35. Which of the following is a soluble base in water?

(A) $Fe(OH)_3$ (B) $Cu(OH)_2$

(C) $Zn(OH)_2$ (D) NaOH

36. Which of the following is a weak base

(A) NaOH (B) KOH

(C) NH_4OH (D) $Ca(OH)_2$

ACIDS, BASES & SALTS				ANSWER KEY							EXERCISE				
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	A	D	C	C	B	A	C	D	C	A	A	C	A	D
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	B	D	C	C	A	B	C	D	C	A	B	D	B	B	A
Que.	31	32	33	34	35	36									
Ans.	A	C	B	D	D	C									